Government of the People's Republic of Bangladesh
Ministry of Water Resources
Bangladesh Water Development Board
Water Resources Planning Organization

COMPARTMENTALIZATION PILOT PROJECT, TANGAIL

Final Phase

INCEPTION REPORT

VOL 2: ANNEX	1	: SECTORAL ANALYSIS -AN OVERVIEW ←
VOL 2: ANNEX	1A	: WATER MANAGEMENT / ENGINEERING
	1B	: AGRICULTURE
	1C	: FISHERIES
	1D	: ENVIRONMENT
	1E	: INSTITUTIONS (INTER-ORGANIZATIONAL)
	1F	: WOMEN & DEVELOPMENT
	1G	: MONITORING & EVALUATION/ECONOMICS
VOL 2: ANNEX	2	: EXECUTIVE SUMMARY REFORMULATION MISSION REPORT
VOL 2: ANNEX	3	: TOR CPP FINAL PHASE
VOL 2: ANNEX	4	: MoU DONOR REVIEW MISSION

April 1997

LAHMEYER INTERNATIONAL GMBH, Germany

in Association with

Haskoning - Consulting Engineers & Architects, The Netherlands
Consultants for Development Programmes (CDP), The Netherlands
Development Design Consultants Ltd. (DDC), People's Republic of Bangladesh

Donors:

Directoraat Generaal Internationale Samenwerking, Government of the Netherlands

and

Kreditanstalt für Wiederaufbau, Federal Republic of Germany

FAP-20

2

Government of the People's Republic of Bangladesh
Ministry of Water Resources
Bangladesh Water Development Board
Water Resources Planning Organization

COMPARTMENTALIZATION PILOT PROJECT, TANGAIL

Final Phase

INCEPTION REPORT

VOL 2: ANNEX 1 : SECTORAL ANALYSIS -AN OVERVIEW ←
VOL 2: ANNEX 1A : WATER MANAGEMENT / ENGINEERING
1B : AGRICULTURE
1C : FISHERIES
1D : ENVIRONMENT
1E : INSTITUTIONS (INTER-ORGANIZATIONAL)
1F : WOMEN & DEVELOPMENT
1G : MONITORING & EVALUATION/ECONOMICS
VOL 2: ANNEX 2 : EXECUTIVE SUMMARY REFORMULATION MISSION REPORT
VOL 2: ANNEX 3 : TOR CPP FINAL PHASE
VOL 2: ANNEX 4 : MoU DONOR REVIEW MISSION

April 1997

LAHMEYER INTERNATIONAL GMBH, Germany

in Association with

Haskoning - Consulting Engineers & Architects, The Netherlands
Consultants for Development Programmes (CDP), The Netherlands
Development Design Consultants Ltd. (DDC), People's Republic of Bangladesh

Donors:

Directoraat Generaal Internationale Samenwerking, Government of the Netherlands

and

Kreditanstalt für Wiederaufbau, Federal Republic of Germany

TABLE OF CONTENTS

ANNEX 1: SECTORAL ANALYSIS - AN OVERVIEW 3

1. INTRODUCTION 3

2. THE SPECIFIC ACTIVITIES 4

3. OVERVIEW SECTOR SPECIFIC ACTIVITIES, PERSONNEL PLANNING AND BUDGET 7

LIST OF FIGURES

Figure 1.1: Analytical Framework 5
Figure 1.2: Time Frame 6
Figure 3.1: Personnel schedule CPP 8
Figure 3.2: Detailed workplan, personnel planning and budget : Watermanagement/Engineering 9
Figure 3.3: Detailed workplan, personnel planning and budget : Agriculture 10
Figure 3.4: Detailed workplan, personnel planning and budget : Fisheries 11
Figure 3.5: Detailed workplan, personnel planning and budget : Environment 12
Figure 3.6: Detailed workplan, personnel planning and budget : Institutions 13
Figure 3.7: Detailed workplan, personnel planning and budget : Women & Development 15
Figure 3.8: Detailed workplan, personnel planning and budget : Monitoring & Evaluation 16

ANNEX 1: SECTORAL ANALYSIS - AN OVERVIEW

1. INTRODUCTION

The Main Report (Vol 1) has clearly laid out the framework for an adjusted approach towards the planned activities into CPP-Final Phase.

This Volume 2 contains four annexures.

Annex 1 in itself specifically examines and explains the activities to be developed under CPP-Final Phase for general management purposes and covers all main sections.

A summary of these detailed activities are indicated in Volume 1 : Main Report. As the institutuional part of the analysis on the functionality, sustainability, viability and replicability has played a prevailing role in the CPP-Final Phase, this part was already included entirely in the Volume 1: Main Report.

Annex 2, 3, 4 respectively cite the Executive Summary Reformulation Mission Report (October 1995), ToR-CPP Final Phase (June 1996-June 2000) and the MoU Donor Review Mission (February-March 1997).

The issue of a proper formulation of the Mitigation Measures is under preparation, as the first results of the newly setup monitoring and evaluation unit are becoming available. In the various sectoral analysis, mitigative measures have been partially formulated already. The analysis of the M&E results may be further elaborated upon as information becomes available. As the M&E database is expected to be fully operational at the end of 1997, a comprehensive set of mitigation measures will be formulated at that time.

An aspect which has not been mentioned explicitly in this Volume 2 is Training and Information Dissemination. Regarding the training component for the separate sections, these are already mentioned per section.

Regarding the Information Dissemination Mechanism, its specific activities, personnel planning and budget a particular concern needs to be expressed here. The organizational setting from which CPP itself is part of (i.e. within Ministry of Water Resources, Bangladesh Water Development Board, Water Resources Planning Organization etc.), is at the moment in a state of changes. Especially the upcoming National Water Master Plan, the role which WARPO will play, the coordinating function etc. is expected to be adjusted/changed shortly. As soon as the National Water Master Plan will start its activities, CPP will approach WARPO to embed the fully operational information dissemination mechanism from CPP into the national context. Details for this approach need to be worked out as soon as the NWMP starts its activities. The finalization of CPP's planned activities for the Information Dissemination Mechanism should coincide with the finalization of the Inception Phase of the National Water Master Plan, Annex 1A-Annex 1G all start with a quick overview sheet where in one page a time frame is being indicated together with key programmes. Annex 1E does not have this sheet as it would confuse.

2. THE SPECIFIC ACTIVITIES

The analytical framework (Figure 1.1) depicts the Phases of CPP, from its first inception phase (end 1992), to the inception Final Phase (begin 1997). The other components, as they actually occurred, are also shown. Although originally perceived as a project which could be implemented and evaluated within a few year's it turned out to be that the perceived time frame as stiuplated in the original identification mission and laid down in the ToR (First Phase) was too confined. The institutional framework, the institutional consequences and its functionally were very much underestimated regarding time allocation. Furthermore, the attention which was paid to aspects related to environment and women and development issues, were during the first few years, very limited. Nationally and internationally, more emphasis was allocated to these aspects. The perception on how people's participation should be translated into practical terms, was and still is not will defined and very much open to discussion. As how people's participation in the water sector in Bangladesh is under intensive discussion, and the fact that only few proejcts have active experience with this, the debate will certainly continue for some years. This intensive discussion will prevail untill this experience is indeed properly established in different types of projects.

As long as this people's participation process cannot be properly assessed, and a national consensus being formulated, this discussion will continue. The experiences within CPP regarding this aspect are clearly in favour of a broadly based support for an institutional framework which can carry this responsibility.

The consequences towards operation and testing, monitoring and evaluation are open, as the current institutional set-up requires adjustment to make the system sustainable and replicable for similar project-settings.

The planned evaluation of the project activities in the year 2000, will be a difficult job as part of the testing (physical and institutional) which will only cover a few years at maximum. In principle, only the monsoons of 1997, 1998 and 1999 will provde opportunity to test the compartment, while the eventual occurrence of hydrological "dry years" may even reduce this to less than three monsoons.

In order to give "the concept" a fair chance, this monitoring and evaluation period should be extended to a number of years beyond 2000 to allow for proper impact studies. Regular reporting and final reporting (general, management and specific sectionwise) should be performed (Figure 1.2).

anafrane - 19 Feb 97 - BP & MH - VISIO

Fig 1.1 ANALYTICAL FRAMEWORK

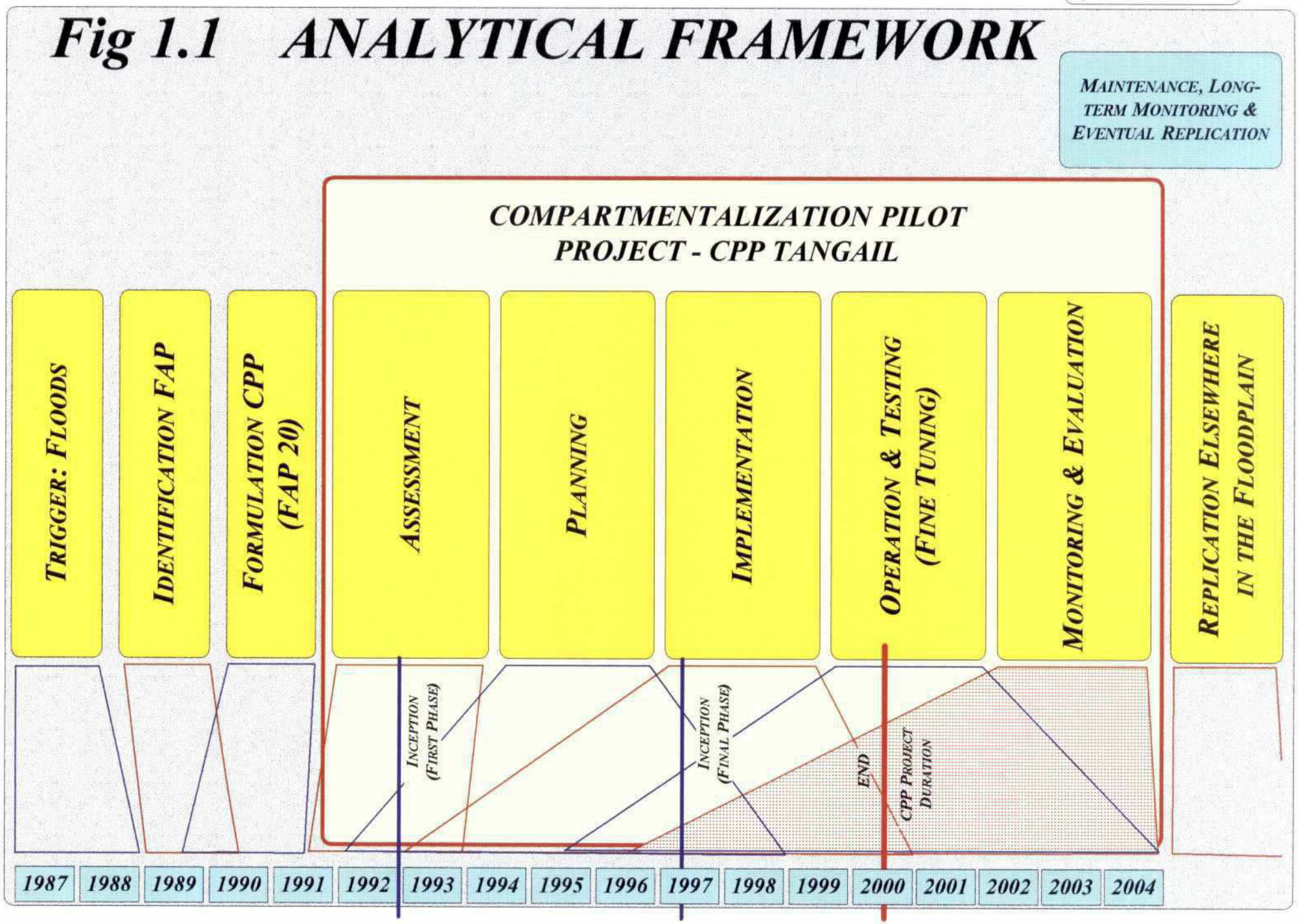
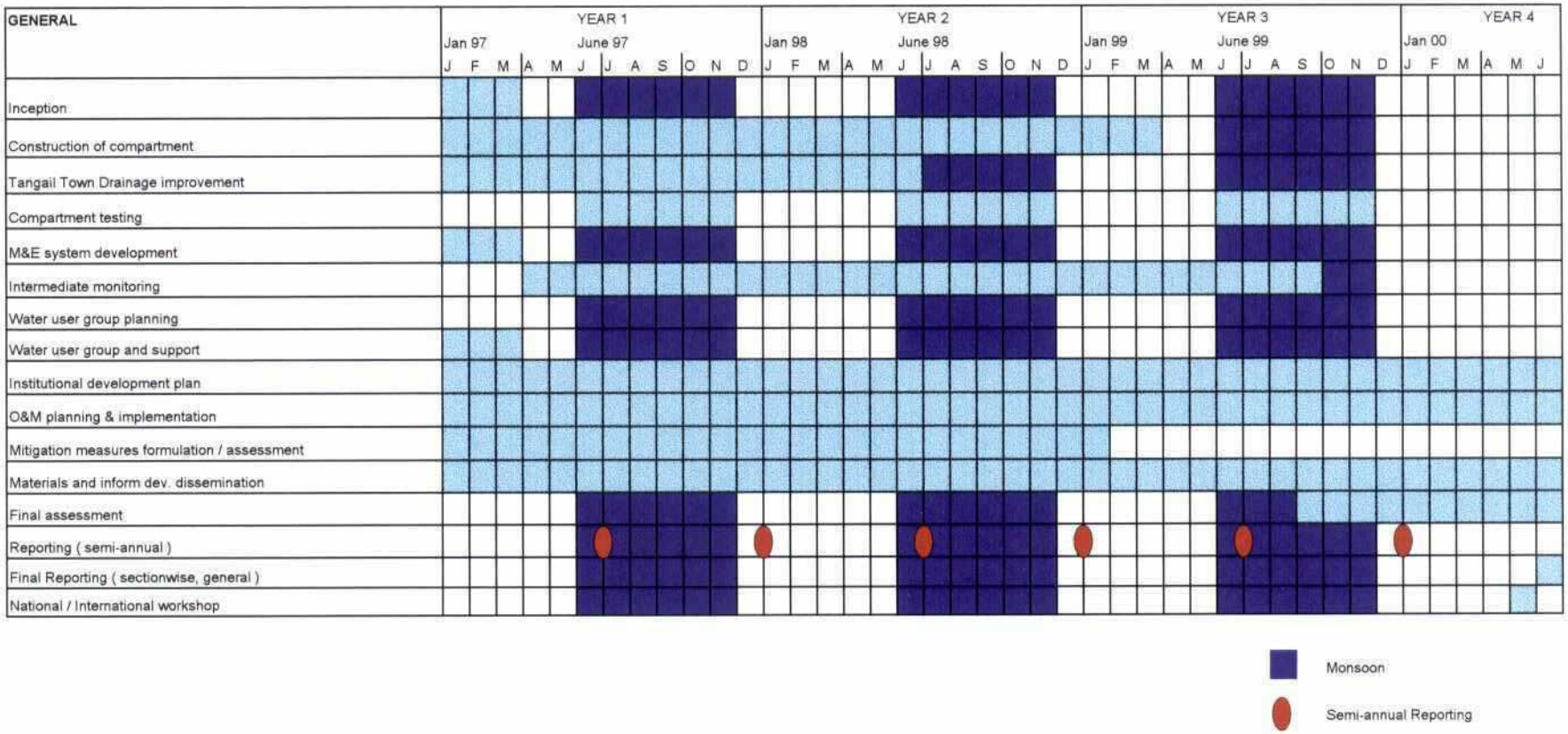


Fig 1.2 : TIME FRAME

ACTIVITY



3. OVERVIEW SECTOR SPECIFIC ACTIVITIES, PERSONNEL PLANNING AND BUDGET

A further fine tuning of the generally defined activities can be found in Figure 3.1 (personnel schedule CPP, Final Phase) and Figures 3.2 - 3.8 (specific activities, personnel planning and budget; sectorwise).

Fig 3.1 PERSONNEL SCHEDULE CPP

STAFFING SCHEDULE — **INTEGRATED TEAM COMPARTMENTALIZATION PILOT PROJECT CPP-FAP 20 (FINAL PHASE)**

Project Year: mid Sept 96 | Jan 97 | July 97 | Jan 98 | July 98 | Jan 99 | July 99 | Jan 2000 | 1 July 200

Sl No.			Int./Lo	MM (#)	Intrn. MM (#)	Local MM (#)	OB ** Team MM	Augm. 1/4/97 MM
1	Project Director/Superint. Engg.	Salahuddin M. Humayun	Lo.			45.5		6.5
2	Team Leader	Armand Evers	Int.	41.0				6.0
3	Deputy Director					45.5		6.5
4	Deputy Teamleader	Noor H. Sarker /	Lo.		42.5			5.5
5	Monitoring & Evaluation Spec.	Harm Jan Raad	Int.	13.0				1.0
6	Monitoring & Evaluation Spec.	Emdadul Haque	Lo.		42.5			6.5
7	Inst. Development Specialist	.....	Lo.				24.0	0.0
8	Inst. Development Specialist	Pieter Jan Zijlstra	Int.	10.0				1.0
9	Inst. Development Specialist	Monzurul Hoque	Lo.		19.5			6.5
10	Executive Engineer	Sharif-Al-Kamal	Lo.			45.5		6.5
11	Construction Engineer	Tjeerd Fekkes	Int.	4.0				1.0
12	Quality Control Engineer	A.C. Sarker	Lo.		24.0			6.0
13	Water Management Engineer	Johan Groot	Int.	9.5				1.5
14	Hydrological Modelling Engineer	.....		6.0				0
15	Environmentalist	Thomas Petermann	Int.	3.0				1.0
16	Environmentalist	Monowar Talukder	Lo.		24.5			6.0
17	Dy. Chief Extension Officer	Ferdous Azad	Int.			45.5		6.0
18	Agronomist/Farming Systems	Henk Mutsaers	Int.	4.0				1.0
19	Agronomist/Farming Systems	Md. Hasmatullah Fakir	Lo.		19.5+9			6.5
20	Credit Specialist *)	.....	Lo.			45.5		0.0
21	Economist	Richard Wiens	Int.	4.5				1.0
22	Economist	R.A. Bhuiyan	Lo.		19.5			6.5
23	Sociologist (female) *)	Farida Akhtar	Lo.				45.5	6.0
24	Women in Development Spec.	Marianne Nugteren	Int.	4.0				1.2
25	Women in Development Spec.	Shamsun Nahar /	Lo.		19.5+6.5			6.0
26	Fisheries Specialist	Kamal Uddin /	Lo.		19.5		45.5	5.0
27	Fisheries Specialist		Int.	0.0				0.0
28	GIS Engineer	Mehdi Hasan /	Lo.		14.5			5.0
29	Project Coordinator	Michael Chegwin	Int.	0.75				0.3
30	Unallocated		Int.	2.75				0.0
31	Unallocated		Lo.		2.5			18.0
Bilateral Associate Experts *)**								
32	GIS / Water Management Spec.	Expected in June '97	Int.					
33	Farming System / WID Spec.	(under formulation)	Int.					
34	Fisheries Specialist	(under request to DGIS)	Int.					
Support Staff								
35	Miscellaneous							
	TOTAL:			96.5	224.5	182.0	115.0	117.5

*) The credit specialist and sociologist (female) will be financed under Financial Assistance (Augmentation Team) as there will be no credit specialist necessary immediate recruitment can take place for on institutional specialist. In July '98 the institutional development specialist from the consultants team will be shifted to the Augmentation Team

**) The manpower input from Government of Bangladesh has only been identified for ranks at executive engineer position and higher.

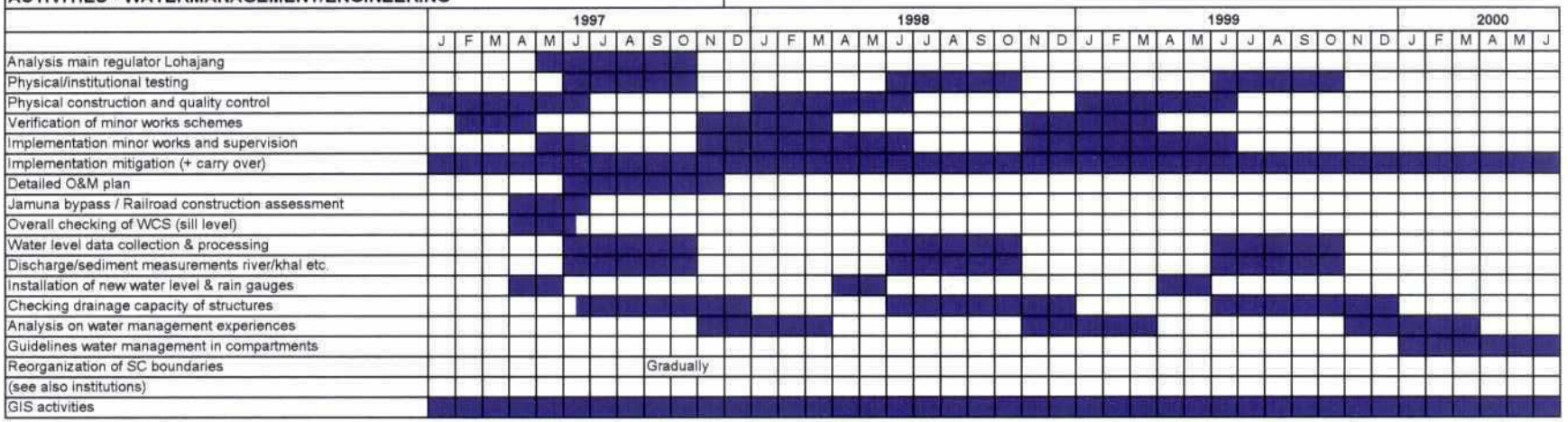
***) The bilateral associate experts are financed directly under DGIS and are therefore not budgetted for under the CPP-budget (TA).

#) According to technical proposal, June 1996.

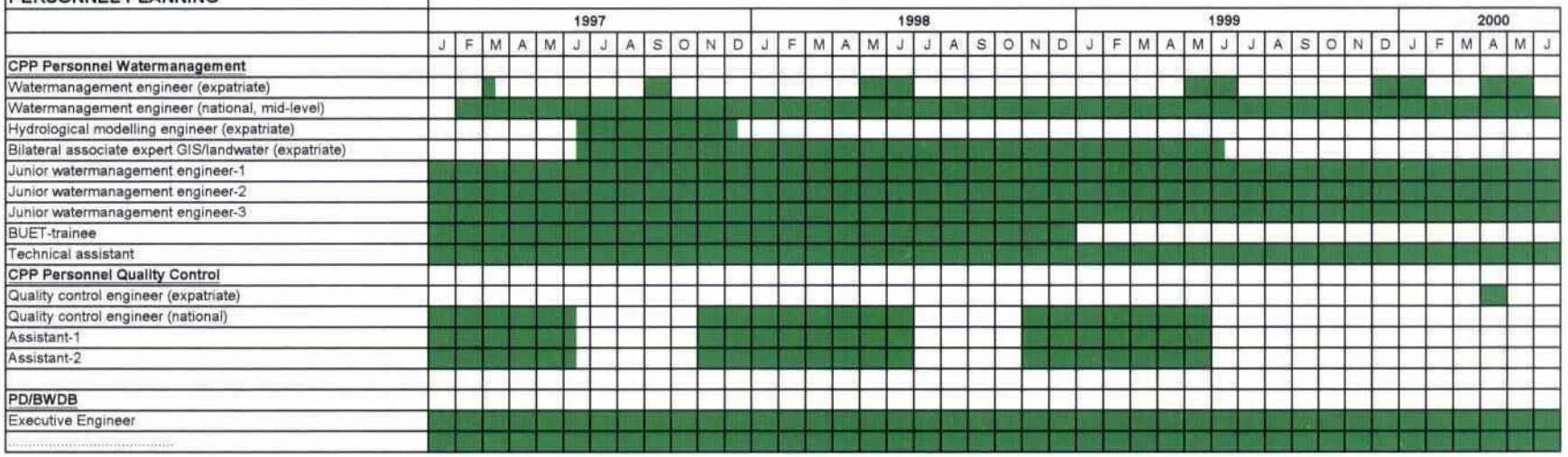
v) Pro. to be financed under "contingencies"

GoB-finance
TA-finance
FA-finance

FIGURE 3.2: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET:
ACTIVITIES - WATERMANAGEMENT/ENGINEERING



PERSONNEL PLANNING

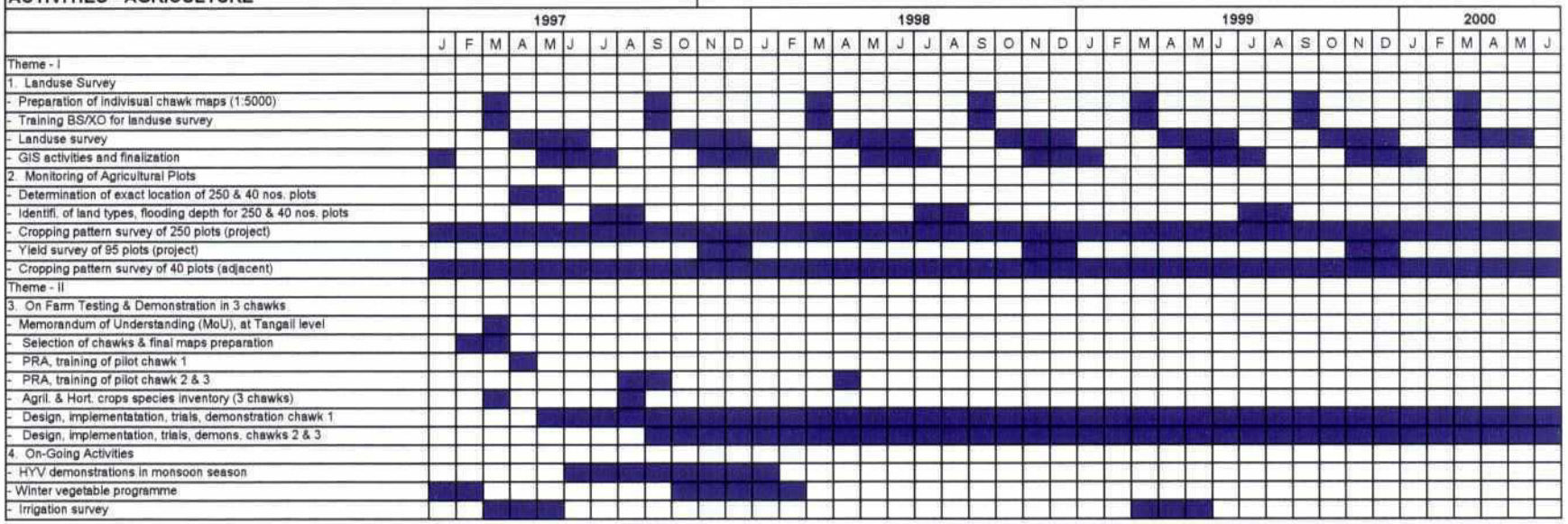


BUDGET

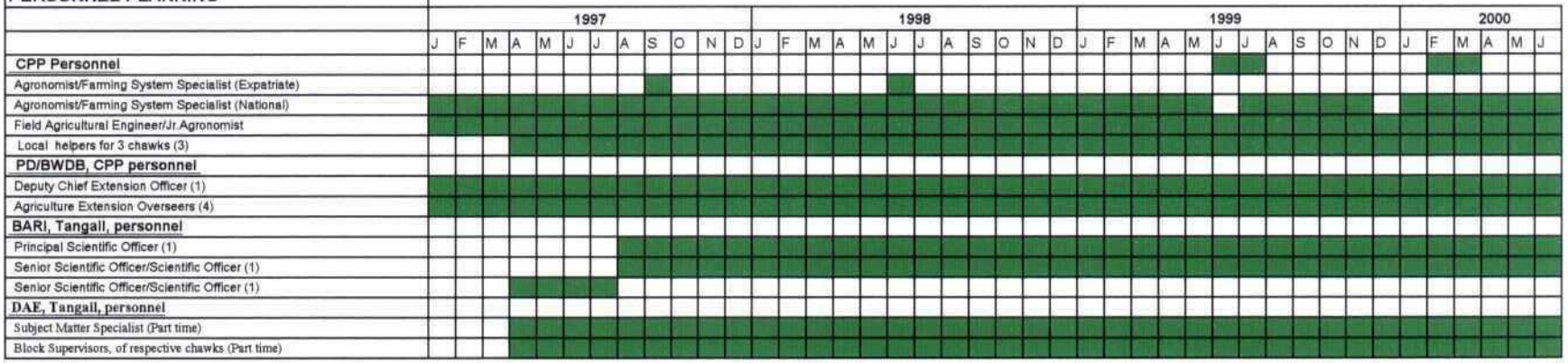
	1997	1998	1999	2000	TOTAL
Hydrometeorological survey	14000	5000	5500	1000	25,500
Sediment survey (quantative)	1500	1500	1500	0	4,500
GIS	10000	6000	4000	2000	22,000
Quality control	9500	4000	1500	500	15,500
Database development	5000	2000	2000	2000	11,000
Hydrological model	5000	8500	3000	3000	19,500
Miscellaneous	5000	3000	2500	1500	12,000
TOTAL :	**50,000**	**30,000**	**20,000**	**10,000**	**110,000**

FIGURE 3.3: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET:

ACTIVITIES - AGRICULTURE



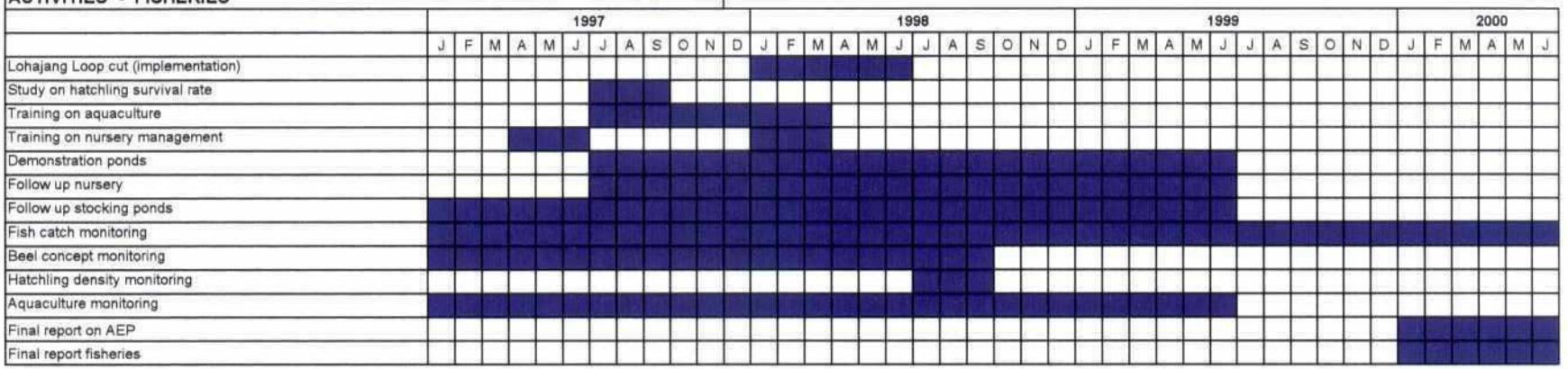
PERSONNEL PLANNING



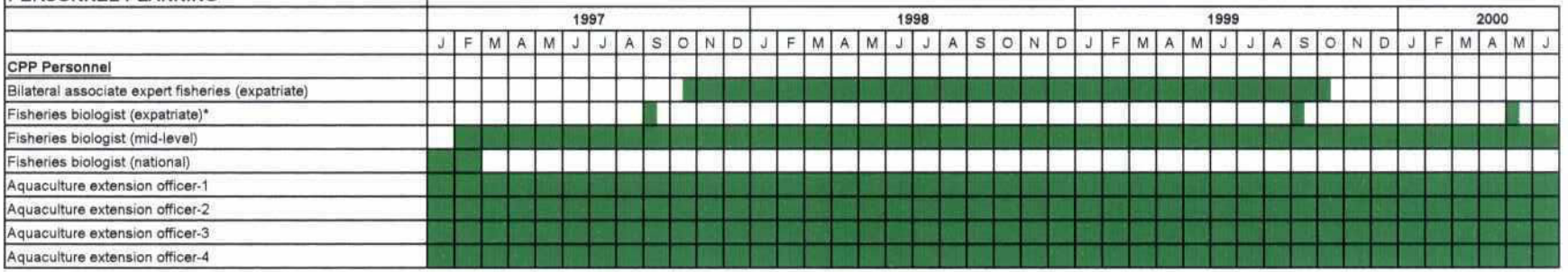
BUDGET

	1997	1998	1999	2000	TOTAL
1. LANDUSE SURVEY	4000	4000	4000	2000	14000
2. OFTD					
Training and PRA	500	1000	1000	500	3000
Development Training Materials	2000	2500	3000		7500
Test and Demonstrators	5000	7500	7500	5000	25000
Interdepartmental cooperation	4500	6000	7500	7500	25500
3. ONGOING ACTIVITIES					
HYV demonstrations	4000				4000
Winter vegetable	-	4000			4000
Irrigation survey	2000		2000		4000
TOTAL (1+2+3)	**22500**	**25000**	**25000**	**15000**	**87000**

FIGFURE 3.4: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET:
ACTIVITIES - FISHERIES



PERSONNEL PLANNING



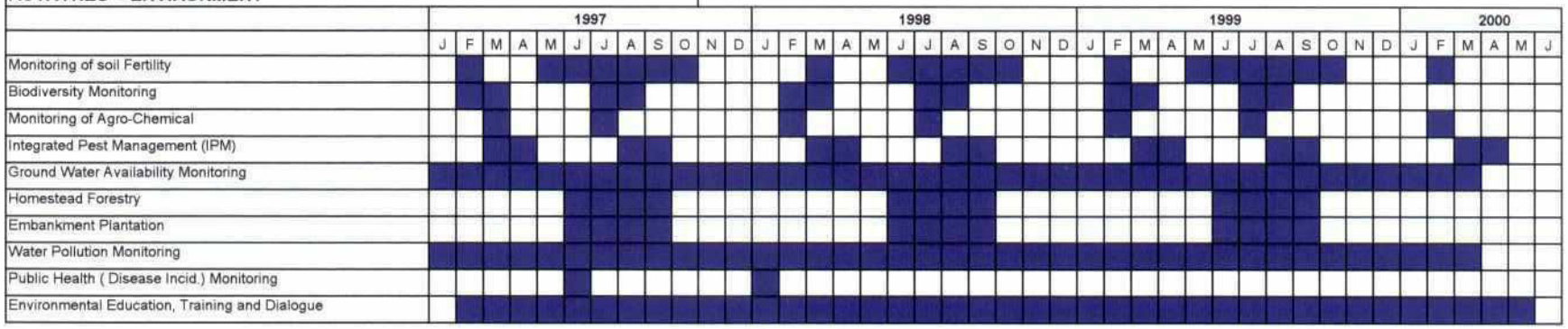
BUDGET

	1997	1998	1999	2000	TOTAL
Catch assessment	5000	4000	4000	0	13,000
Hatchling migration	5000	4000	-	-	9,000
Training AEP	5000	5000	3000	2000	15,000
Mitigation program professional fisherman	17000	17000	12000	5000	51,000
Miscellaneous	3500	3000	2000	3500	12,000
TOTAL :	**35,500**	**33,000**	**21,000**	**10,500**	**100,000**

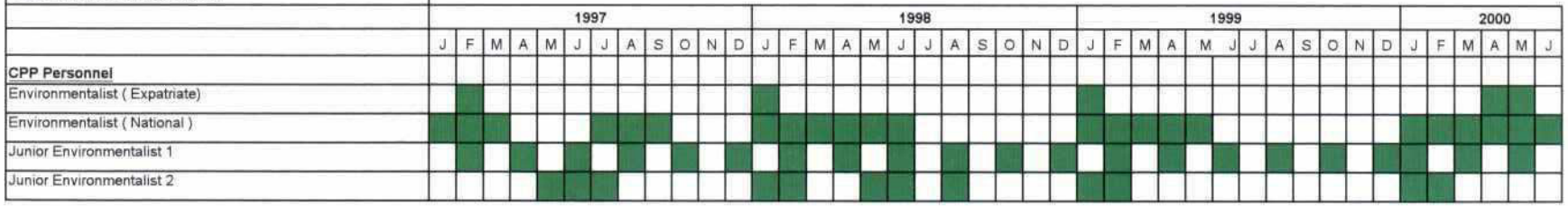
*) Time allocation will take place from unalloted expatriate manmonths.

FIGURE 3.5: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET

ACTIVITIES - ENVIRONMENT



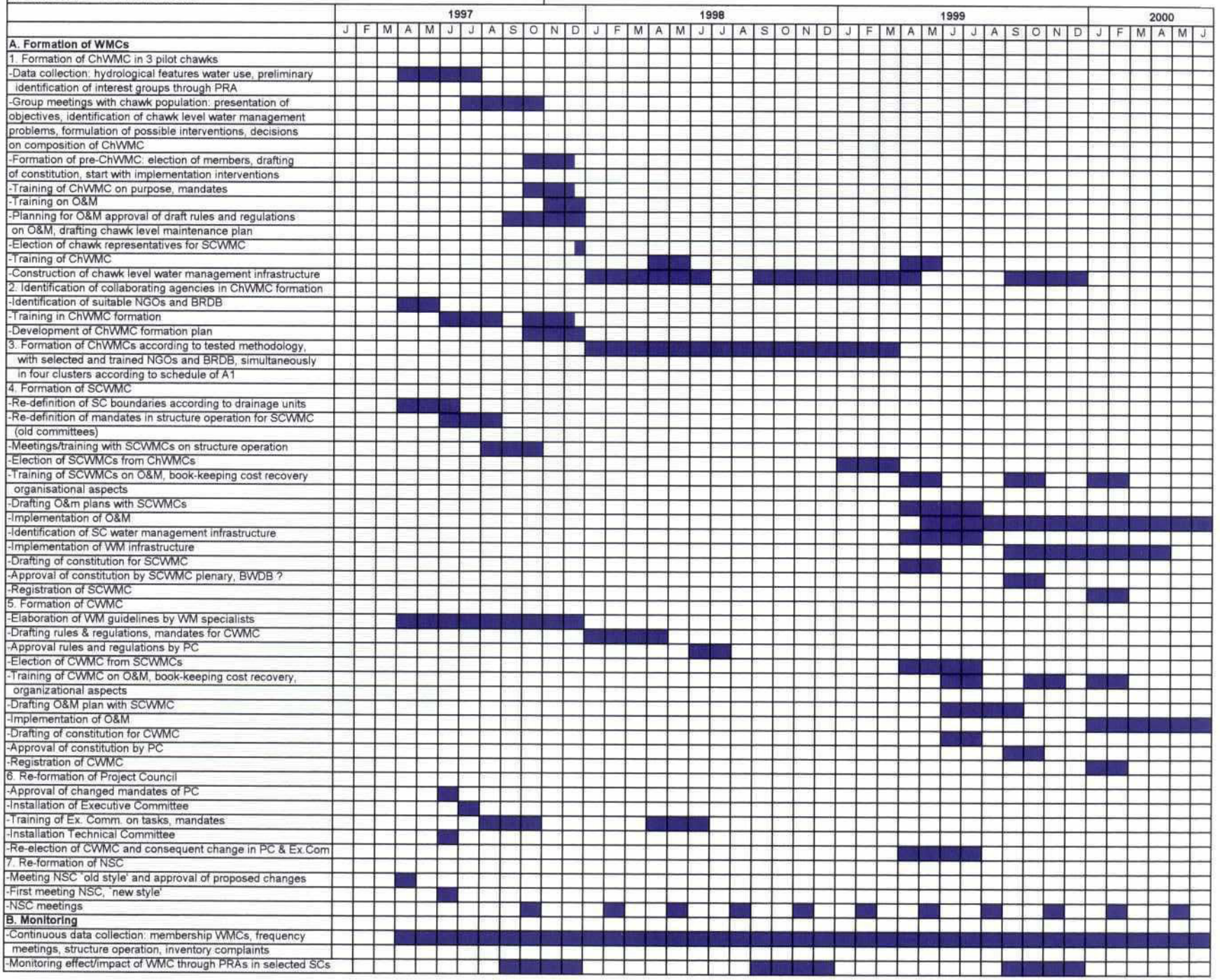
PERSONNEL PLANNING



BUDGET

	1997	1998	1999	2000	TOTAL
Monitoring of soil fertility	9000	4000	6000	4000	22000
Bio-diversity monitoring	6000	2000	3000	3400	17000
Monitoring of agro-chemical	700	500	500	500	2000
Integrated pest management (IPM)	2000	2000	2000	800	6000
Ground water availability monitoring	0	0	0	1500	2000
Homestead forestry/embankment plantation	5000	5000	5000	300	15000
Water pollution monitoring	8000	7000	4000	500	15000
Public health (disease incid.) monitoring	0	0	0	1000	2000
Environmental education, training & dialogue	4300	4500	4500	3000	19000
TOATAL:	**35000**	**25000**	**25000**	**15000**	**100000**

FIGURE 3.6: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET: ACTIVITIES - INSTITUTIONS



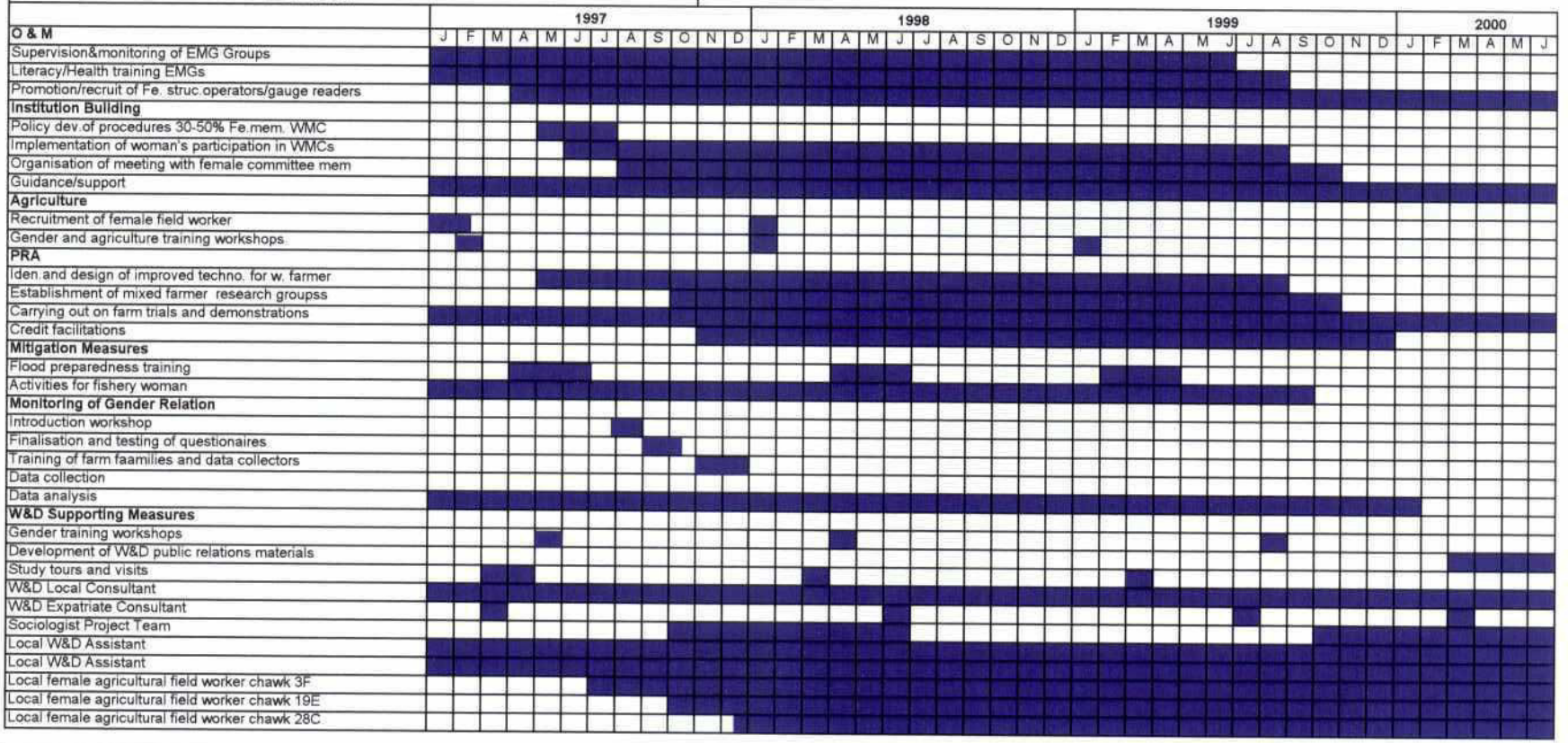
PERSONNEL PLANNING

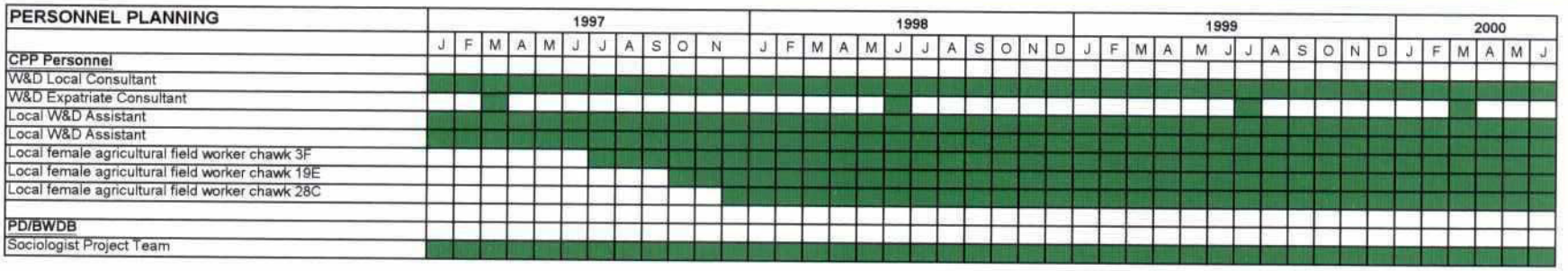
	1997												1998												1999												2000					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
CPP Personnel																																										
Institutional specialist (expatriate)			■						■					■								■					■						■							■	■	■	■
Institutional specialist (national)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Deputy team leader (national)	■	■			■	■			■	■			■	■			■	■			■	■			■	■			■	■			■	■			■	■			■	■
Institutional coordinator (special)						■	■	■	■	■	■	■	■	■	■	■	■																										
PD/BWDB																																										
Institutional specialist 1																		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Inter-organizational facilitator	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Female sociologist (part time)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

BUDGET

	1997	1998	1999	2000	TOTAL
A. Formation of WMCs					
1. Formation of ChWMC in 3 pilot chawks					
3. Formation of ChWMCs according to tested methodology					
4. Formation of SCWMC	200000	80000	80000	70000	430,000
5. Formation of CWMC					
6. Re-formation of project council					
B. Monitoring	20000	20000	20000	10000	70,000
TOTAL :	**220,000**	**100,000**	**100,000**	**80,000**	**500,000**

FIGURE 3.7: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET: ACTIVITIES - WOMEN & DEVELOPMENT

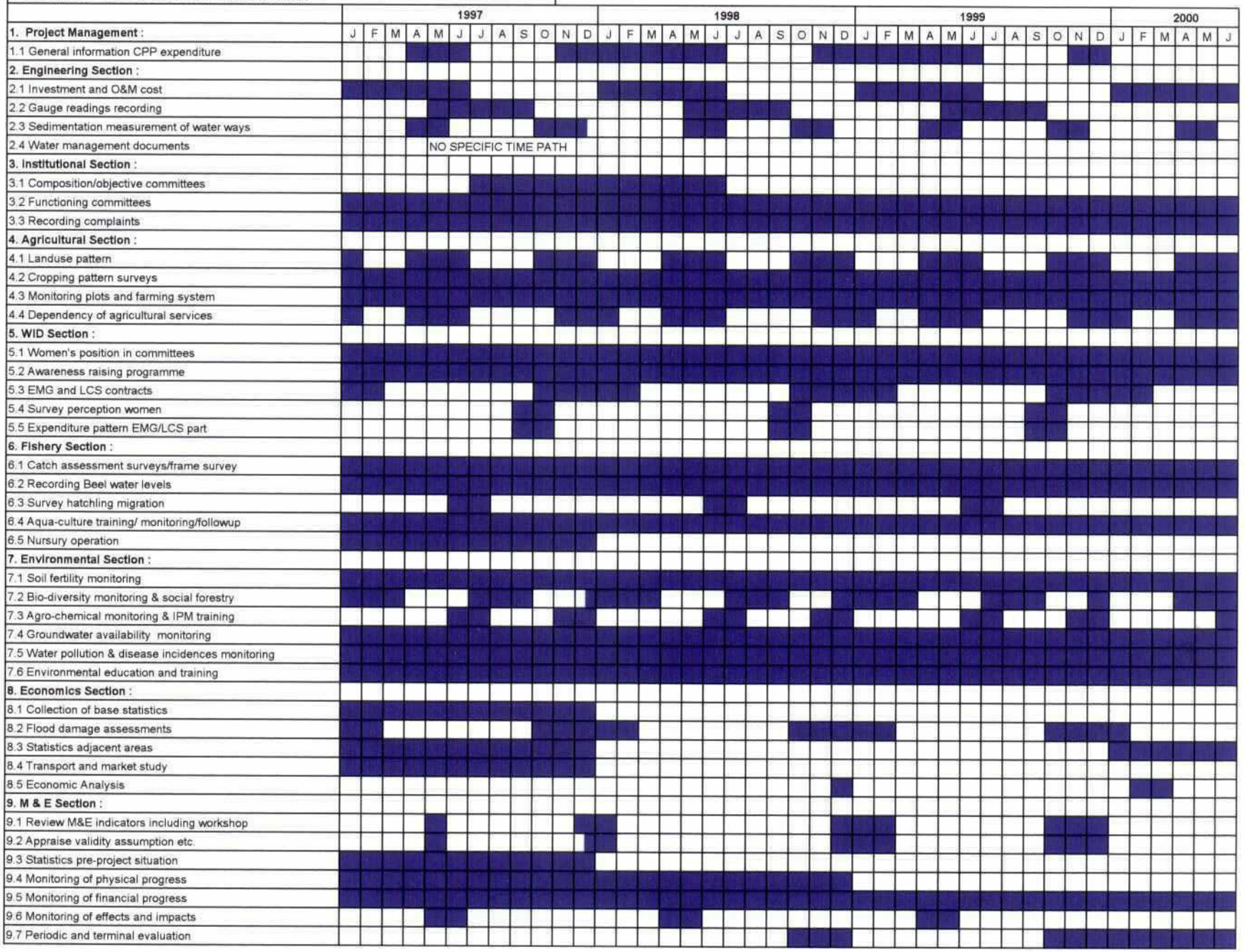




BUDGET

	1997	1998	1999	2000	TOTAL
O & M	4000	5000	9000	2000	20000
Institutional building	5000	3000	1000	1000	10000
Agriculture	17000	9000	6500	2500	35000
PRA	4000	5000	4000	2000	15000
Monitoring of gender	5000	5000	3500	1500	15000
W&D supporting	28000	10000	3000	9000	50000
Mitigation measures	7000	3000	3000	2000	15000
TOTAL:	**70000**	**40000**	**30000**	**20000**	**160000**

FIGURE 3.8: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET: ACTIVITIES - MONITORING & EVALUATION



PERSONNEL PLANNING	1997											1998												1999												2000					
	J	F	M	A	M	J	J	A	S	O	N	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
CPP Personnel																																									
Monitoring & evaluation specialist (expatriate)																																									
Monitoring & evaluation specialist (national)																																									
Monitoring & evaluation assistant (2x)																																									
ECONOMICS																																									
CPP Personnel																																									
Economist (expatriate)																																									
Economist (national)																																									
Economic assistant																																									

BUDGET					
	1997	1998	1999	2000	TOTAL
Computer hardware + software	10000	5000	-	-	15,000
Publications		4000	4000	4000	12,000
Expert household survey			-	20000	20,000
Economic surveys	5000	5000	10000	-	20,000
Data processing support	2500	2500	2500	2500	10,000
Consultations	2000	2000	2000	2000	8,000
Survey personnel (temp.)	5000	5000	5000	-	15,000
TOTAL:	**24500**	**23500**	**23500**	**29000**	**100,000**

Government of the People's Republic of Bangladesh
Ministry of Water Resources
Bangladesh Water Development Board
Water Resources Planning Organization

COMPARTMENTALIZATION PILOT PROJECT, TANGAIL

Final Phase

INCEPTION REPORT
VOL 2: ANNEX 1 : SECTORAL ANALYSIS -AN OVERVIEW
VOL 2: ANNEX 1A : WATER MANAGEMENT/ENGINEERING ←
1B : AGRICULTURE
1C : FISHERIES
1D : ENVIRONMENT
1E : INSTITUTIONS (INTER-ORGANIZATIONAL)
1F : WOMEN IN DEVELOPMENT
1G : MONITORING & EVALUATION/ECONOMICS
VOL 2: ANNEX 2 : EXECUTIVE SUMMARY REFORMULATION MISSION (OCT. 1995)
VOL 2: ANNEX 3 : TOR CPP FINAL PHASE
VOL 2: ANNEX 4 : MoU DONOR REVIEW MISSION

April 1997

LAHMEYER INTERNATIONAL GMBH, Germany

in Association with

Haskoning - Consulting Engineers & Architects, The Netherlands
Consultants for Development Programmes (CDP), The Netherlands
Development Design Consultants Ltd. (DDC), People's Republic of Bangladesh

Donors:

Directoraat Generaal Internationale Samenwerking, Government of the Netherlands

and

Kreditanstalt für Wiederaufbau, Federal Republic of Germany

TABLE OF CONTENTS

ANNEX 1A: WATERMANAGEMENT / ENGINEERING 6

1. INTRODUCTION 6

2. CONCEPTS IN COMPARTMENTALIZATION 8
2.1. General concepts 8
2.2. Compartmentalization at national level in Bangladesh 8
2.3. Sub-compartments 8

3. UNITS FOR WATER MANAGEMENT 10
3.1. Secondary embankments in the Tangail Compartment 10
3.2. Chawks 10
3.3. Sub-compartments 10
3.4. Clusters 11
3.5. Systems 11

4. TASKS FOR WATER MANAGEMENT 12
4.1. Flood protection 12
4.2. Drainage and water management 12
4.3. Controlled flooding 12

5. ELEMENTS OF INFRASTRUCTURE 14
5.1. Water infrastructure 14
5.2. The embankment of the Compartment 14
5.3. The Main Regulator 14
5.4. The Lohajang river 14
5.5. Peripheral infrastructure 16
5.6. Infrastructure along the Lohajang river 16
5.7. The internal infrastructure 16

6. INFRASTRUCTURE PER CLUSTER 23
6.1. Infrastructure in Cluster 1b 23
6.1.1. Water intake 23
6.1.2. Drainage capacity 24
6.1.3. Spilling at Santosh 24
6.2. Infrastructure in Cluster 2 25
6.2.1. General 25
6.2.2. Water intake 25
6.2.3. Drainage capacity 26
6.3. Infrastructure in Cluster 3 26
6.3.1. Water intake 26
6.3.2. Drainage capacity 27
6.3.3. Boundary conditions in the south 27
6.4. Infrastructure in Cluster 4 28
6.4.1. Water intake 28
6.4.2. Drainage capacity 29

7. WATER MANAGEMENT 30
7.1. Current priorities in water management 30
7.2. New priorities 30
7.3. Implementation of the new priorities 32
7.3.1. Reorganising sub-compartment boundaries 32
7.3.2. Decentralisation 33

7.4. Manuals and procedures 33
7.4.1. Synchronising water level targets 33
7.4.2. By-laws and regulations 34
7.4.3. Agreements on O&M 34

8. WATER LEVEL GAUGES 35
8.1. Gauge readings 35
8.2. Keeping records 35

9. HYDRAULIC MODELLING 36

10. INSTITUTIONAL ISSUES 38
10.1. Issues forgone 38
10.2. SCWMCs and Local Government 38
10.3. Operation and Maintenance 39
10.3.1. Operation of internal infrastructure 39
10.3.2. Operation of primary infrastructure 39
10.3.3. Maintenance 40

11. ENGINEERING (INCLUDING "MINOR WORKS") 41
11.1. Introduction 41
11.2. Minor works activities 43
11.3. Overview of work (implemented in FY 96-97), carried-over work and planned work (for FY 97-98) 49

12. DHALESWARI-SPILL-CHANNEL, JAMUNA ACCESS ROAD AND RAILWAY 52
12.1. Dhaleswari closure and opening of a new spill channel and subsequent development 52
12.2. Alignment of By-Pass road and Rail road connecting to Jamuna Bridge through CPP 53

13. PLAN OF ACTIVITIES, PERSONNEL PLANNING AND BUDGET ALLOCATION 56

LIST OF TABLES

Table 5.1: Peripheral inlet structures, CPP 17
Table 5.2: Structures along the Lohajang-river, CPP 17
Table 5.3: Internal infrastructure of the Tangail compartment 22
Table 6.1: Average water levels at Ramdevpur (gauge G35) 23
Table 6.2: Average water level at Rasulpur (gauge 28, Gala khal) 25
Table 6.3: Average water levels at Karatia (gauge 8, Lohajang) 27
Table 6.4: Average water levels in the Elanjani (Goziabari, gauge G12) 28
Table 11.1: Land acquisition status, works FY 96-97 (ongoing) 44
Table 11.2: Land acquisition status, carried over work (ongoing) 45
Table 11.3: Land acquisition status, works planned for FY 97-98 46
Table 11.4: Progress land acquisition current works and works planned; status 2nd quarter 1997 49

LIST OF FIGURES

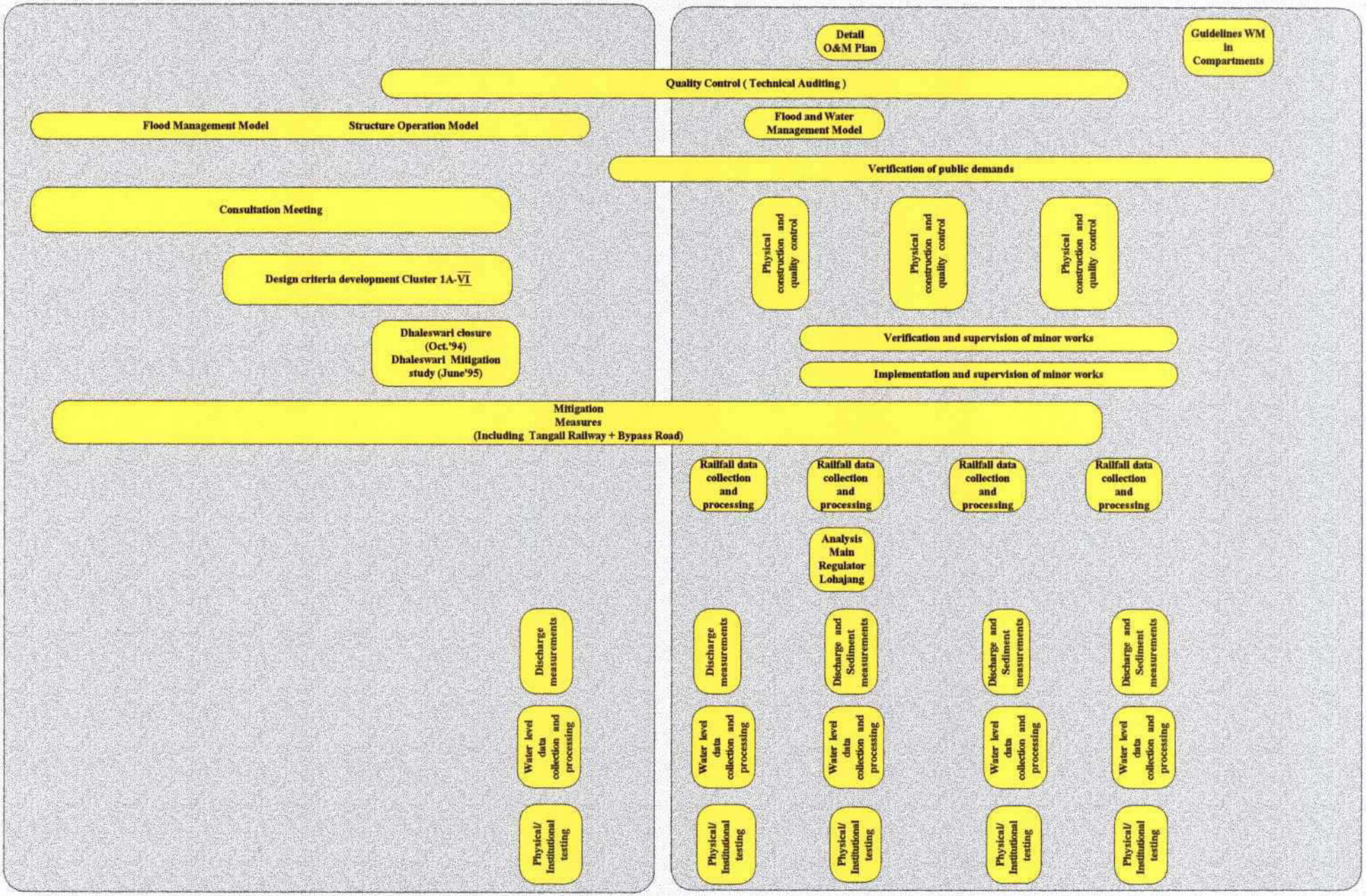
Figure 5.1: Peripheral infrastructure & structures along the Lohajang 15
Figure 5.2A: Internal infrastructure Cluster 1b, with old sub-compartment boundaries 18
Figure 5.2B: Internal infrastructure Cluster 2, with old sub-compartment boundaries 19
Figure 5.2C: Internal infrastructure Cluster 3, with old sub-compartment boundaries 20
Figure 5.2D: Internal infrastructure Cluster 4, with old sub-compartment boundaries 21
Figure 7.1: Example of water level control, Cluster 1b 31
Figure 11.1: Clusters and subcompartments, defined for CPP 42
Figure 11.2: New works for FY 96-97, CPP 47
Figure 11.3: Carried over work from FY 96-97, CPP 48
Figure 11.4: Planned works for FY 97-98 50
Figure 12.1: CPP in connection with the Dhaleswari Closure, Jamuna access road, Tangail By-Pass, and Jamuna Railway 55
Figure 13.1: Detailed workplan, personnel planning and budget : Watermanagement/Engineering 57
Figure A1: Internal infrastructure Cluster 1b, new SC boundaries 66
Figure A2: Internal infrastructure Cluster 4, new SC boundaries 67
Figure A3: Internal infrastructure Cluster 2, (alternative 2) new SC boundaries 68
Figure A4: Internal infrastructure Cluster 2, (alternative 1) new SC boundaries 69
Figure A5: Internal infrastructure Cluster 3, new SC boundaries 70

LIST OF APPENDICES

APPENDIX 1: REVISION OF SUB-COMPARTMENT BOUNDARIES 59
APPENDIX 2: TASKS JUNIOR WATER MANAGEMENT OFFICER (JWMO) 72
APPENDIX 3: LIST OF GAUGES TO BE MAINTAINED 74

Engineering Activities of CPP

engineer.vsd 24 may 97 SR



ANNEX 1A: WATERMANAGEMENT / ENGINEERING

1. INTRODUCTION

This annex describes the analysis of the activities regarding watermanagement and the engineering part, including issues related to the Dhaleswari closure and the Jamuna Railway/Bypass road. Furthermore the compilation of these activities into a detailed workplan, personnel planning and budgets.

This Annex is divided into four parts:

1. Watermanagement;
2. Engineering (including "minor works", quality control);
3. Dhaleswari closure, Jamuna Railway/Bypass road; and
4. Workplan, personnel planning and budget

1. Watermanagement

Compartments in the flood plains of Bangladesh would have the function to reduce floods by temporarily storing runoff waters. In case of the Tangail Compartment the necessity of storing runoff is imposed by outside conditions: it is expected that outside water levels are, so high during some periods of the monsoon that parts of the Compartment can not drain properly.

As far as water management is concerned, it needs to be studied what are the optimal land uses under the prevailing local circumstances. A second subject of study is, whether flooding risks can be reduced on the low lands by improved water measures.

During the first phase of CPP, the project area was sub-divided into sub-compartments, which in turn were split up in chawks. There are 16 sub-compartments in the area, which measures about 13,000 ha. There are about 150 chawks. The sub-compartments and chawks both have a water management function and an institutional function. Improvements in water management will involve local committees, both at chawk and at sub-compartment level.

During CPP's Final Phase, the chawks and sub-compartments will be maintained, but it is proposed to adapt the boundaries of the sub-compartments in such a way that each drainage system is fully contained in one sub-compartment. In the past, one of the difficulties in water management was, that drainage systems crossed the boundaries of sub-compartments. In managing drainage systems, close coordination was sometimes required between two or three sub-compartment committees. The proposed change does away with that complication.

Another change proposed for the Final Phase is that the emphasis shifts from water level control to drainage. During the first phase much attention was given to water level control up to chawk level. That appeared rather complex and not very well manageable. By concentrating on drainage, water management will become easier.

To improve water management, CPP has to establish contacts with the committees. For that purpose Junior Water Management Officers have already been appointed, who will work under supervision of a Drainage / Water Management Engineer. Their task is to assist the committees in their tasks and on the other hand to identify important water management issues.

There is still insufficient knowledge about the behaviour of water levels around the Compartment during the monsoon. Likewise, the behaviour of the Lohajang river is still unknown. During the first phase of CPP, model calculations were done about flooding and drainage, but the model needs to be adapted to the new requirements. Firstly, it will be simplified. Secondly, the model will be transferred to Tangail office in order to improve the communication about model outputs and the field situation. It is a matter of priority that CPP acquires good understanding of the operation of the Main Regulator.

Parallel with the simplication of the management of the system, gauge readings will be reduced and adapted to Project needs.

2. Engineering

The Engineering part discusses the current physical progress, the land acquisition and the guidelines for Minor Works.

3. The Dhaleswari closure and Jamuna Railway/Bypass road

Although the effects of the Dhaleswari closure have been adequately mitigated, a new development also related to the Jamuna Bridge construction has clearly an impact on CPP's activities.

The proposed Jamuna Railway and the Tangail Bypass road as part of the Jamuna Multipurpose Bridge Project, will clearly affect the watermanagement activities in the eastern part of the compartment. The initiatives developed and obtained results with new plans are discussed in this section.

4. Workplan, personnel planning and budget

The compilation of all relevant activities under the section Watermanagement/Engineering is shown in a diagram, together with personnel planning and allocated budget.

2. CONCEPTS IN COMPARTMENTALIZATION

2.1. General concepts

The purpose of this chapter is not to introduce a new definition of compartmentalization but to summarise and evaluate the concepts, which are relevant and necessary to understand the setting properly.

Compartmentalization is an established technique in watershed management. The technique is applied when it is necessary to slow down the runoff of river systems or watersheds or to create independent systems to which different drainage criteria can be applied. By applying the technique, the risks of flooding and/or the size and cost of interventions can be reduced.

Compartments may store excess water temporarily and can do so in two ways:

1. Excess rainfall is temporarily stored in the compartment and is released after high water levels outside have receded. The runoff process is slowed down; and
2. Excess water from upstream parts of the watershed is taken in by more downstream compartments in order to shave peaks downstream.

Under approach 1, the runoff water from sub-systems is temporarily prevented from entering the main system. Under approach 2, the water which is already in the main system is stored in a compartment. Later it is released again, when the high peaks have passed.

2.2. Compartmentalization at national level in Bangladesh

To prevent the almost yearly flooding along the great river systems of Bangladesh, it was visualised to create compartments within their flood plains, over extensive areas. They would shave the peaks by the two mechanisms described: slowing down the runoff, and, taking in water when the approaching peaks are feared to exceed certain maximum levels.

How many of those compartment would be needed in order to have an appreciable impact on the peaks of the major rivers, is not yet known and can not be answered by CPP. Even if the Tangail Compartment were flooded to great depth, the effects on water levels in the surrounding river systems would not be noticeable. In addition, flooding the Compartment for no immediate benefit, would not be acceptable to the land users.

Nevertheless CPP can contribute basic information to compartmentalization at national level. From its databases on land use systems, topography, soils and flooding, the Project is able to establish practical relationships between imperfect drainage conditions, flooding and damages.

2.3. Sub-compartments

As mentioned in the previous section, CPP can not test one of the possible functions of compartments: namely, to flood compartments, when water levels in the main river systems are dangerously high. So, the Project should concentrate on the other aspect: to investigate to what extent agricultural production, including fisheries, can be optimised under conditions of impeded drainage. The latter condition, impeded drainage, is forced upon the Compartment by outside circumstances. During the monsoon, water levels around the Compartment will be so high that large parts of it, lose their opportunity to drain. Excess water needs to be stored temporarily, not so much with the objective to reduce the runoff from the Compartment, but because there is no alternative.

Every compartment of any size contains high lands and low lands. To prevent that high lands drain indiscriminately to the low lands, thereby reducing the production potential of the latter, the sub-compartments were created and established, surrounded by secondary embankments. By creating sub-

compartments, flood damage from rain is spread more evenly over the whole compartment, which is expected to increase overall agricultural production.

This can also be repeated at a lower level. If sub-compartments are considered too large, or if the topography requires so, sub-compartments can be divided another time into units, which have been called chawks in the Tangail Compartment. The chawks have not been divided further.

3. UNITS FOR WATER MANAGEMENT

3.1. Secondary embankments in the Tangail Compartment

The sub-compartments of the Tangail Compartments have the function to prevent accumulation of excess water in low areas after heavy rain. For that function they have been surrounded by secondary embankments. In the ideal situation such embankments would be water tight and follow the contours more or less. In the CPP situation sub-compartment boundaries follow roads (on embankments), but these roads contain numerous bridges and culverts, which allow flow of water across the boundaries. This is valid for most of Bangladesh; secondary embankments are porous and not water tight.

CPP could have been rigid during its first phase and have insisted on making the boundaries of its sub-compartments water tight. This would have caused a flood of complaints from the local population. Upsetting the existing situation too vigorously, would have served nobody. The result is that the present sub-compartment boundaries allow independent water management within the sub-compartments only to a limited extent. It is practical to acknowledge that. It also makes the message to the local population more transparent.

3.2. Chawks

With sub-compartments not being independent hydrological units, chawks are even less. One could ponder the question whether it would be practical if they were. There are so many chawks, (in fact there are more than 150) and some of them are so small, that their water management can not be isolated from that of their neighbours.

One should not conclude from the previous paragraph that chawks are of little use. On the contrary, but their usefulness is not in water management alone. There are three disciplines which may make use of the chawk set-up:

* **Water management.** The chawks provide some protection against outside water conditions and, what is more important, that function could be strengthened by the land users in the chawk;
* **Agriculture.** The chawks provide a practical unit to distinguish land use systems. In most chawks there are dominant land uses, which facilitates the formulation of extension messages to the land users; and
* **Institutional approach.** As CPP wants to improve water management, agricultural production and living conditions, through people participation, the chawks provide a suitable unit to start that process. The sub-compartments are too large for that.

So the proposal is to maintain chawks during the CPP's Final Phase. It is also not considered useful to change chawk boundaries on a large scale. The boundaries of some chawks may have to be adapted, but the impact of such changes on the whole of the Project will be minor.

3.3. Sub-compartments

During the first phase of CPP, sub-compartments were defined as hydrological units although the choices made, contained compromises with existing field conditions. A difficulty was that sub-compartment boundaries had to be defined at an early start of the Project, with insufficient knowledge of the internal water infrastructure at that particular time.

In the present situation, at the start of the Final Phase, drainage patterns and drainage systems have been defined more clearly. It has also become clear that sub-compartments are not only hydrological units. It has always been the intention of CPP to organise water management committees at sub-compartment level. So sub-compartments have an institutional function as well.

One of the major difficulties, which has arisen is that drainage systems cross sub-compartment boundaries. Under the assumption that improvement of drainage is one of the major water management functions of the Tangail Compartment, water management activities need to be co-ordinated primarily per drainage system. Here a conflict arises. If water management is primarily done per drainage system and the drainage system crosses one or two sub-compartment boundaries, water management needs to be co-ordinated with two to three sub-compartment committees. This is a major difficulty for the future management of the system.

The solution to the problem is rather simple. Sub-compartment boundaries can be adapted to the drainage systems. In this way, the institutional and water management set-up run parallel. Proposals to this extent have been formulated in Appendix 1 of this Annex 1A.

3.4. Clusters

Above the sub-compartment level, CPP uses clusters as another sub-division of the Compartment. There are five Clusters with numbers 1a, 1b, 2, 3 and 4. The clusters are there primarily to categorise infrastructure. Project structures have been given a coding according to the cluster in which they are located. The so called peripheral structures, the structures at the outside embankment of the Compartment, belong to Cluster 1a, the internal structures to the Cluster 1b, 2, 3 and 4.

With the proposed changes in sub-compartment boundaries, only the boundary between Cluster 2 and 3 may have to be changed. However, it does not have great urgency. If changing the boundary between Cluster 2 and 3 causes great confusion as far as coding and administration of structures is concerned, it can be avoided.

The boundary between the Clusters 1b and 4 can be maintained without any change.

3.5. Systems

Besides chawks, sub-compartments and clusters, CPP also knows systems. Systems are easily recognisable from a chawk map. All chawks carrying an initial number 1 belong to system 1, those with number 2 are part of system 2 etc. In total there are 31 systems.

Systems are sub-units of sub-compartments and represent catchment areas of drains and their structures. However, there are a number of examples where drains flow from one system to another within the same sub-compartment. If sub-compartments are made to adapt to the drainage systems, systems lose a great part of their significance.

During CPP's Final Phase, the emphasis on systems as hydrological units should be reduced. It may even be considered not to use the system concept, as hydrological unit, any more. They should not be used as water management units. There is no need for an additional management level and re-arranging sub-compartment boundaries renders them more or less redundant.

4. TASKS FOR WATER MANAGEMENT

4.1. Flood protection

Drainage and flood protection are considered the main functions of the infrastructure of the Compartment during CPP's Final Phase. The main embankment along the boundaries in the west, north and east, takes care of a large part of the flood protection. The southern boundary of the Compartment is less protected. If extreme floods occur outside the compartment, there is little that can be done to protect the area.

It is required, however, that more is known about the occurrence of floods which may inundate the Compartment from the south. Information required is about frequencies, levels of flooding and duration.

During the first phase of the Project, daily gauge readings have been taken on water level gauges in waters surrounding the Compartment. Independent of CPP, gauge readings are available on major rivers in the area. The proposal is to correlate gauge readings done by CPP with those on gauges on major rivers, of which longer records exist. It is likely that statistical analyses of the latter readings have already been done. By correlating them to readings nearer to the Project, approximate statistics about water levels outside the Compartment and about the risks of extreme flooding would become available.

Statistical analysis of water levels surrounding the Compartment is also necessary for operation rules concerning the Main regulator and for the analysis of the hydraulic behaviour of the Lohajang. Outside water levels, together with operation scenarios of the Main Regulator determine the upstream water levels in the Lohajang. Outside water levels near to outflow of the Lohajang determine the downstream level in the river.

4.2. Drainage and water management

Drainage should be considered the most important function of the Compartment and its infrastructure. However, drainage is not only about evacuating excess water from the land. A main objective of the drainage is that it occurs in such a way that drainage of the high lands takes place without great damage to the low lands. It is here that the water management aspect comes in.

Reduction of damages can be done by protective measures at chawk level, by protection measures along the drains and by agricultural measures, for instance, adapting the land use system to prevailing water conditions.

A particular example of land use and drainage are the beels and other open water bodies. Criteria have been formulated in the past for optimal conditions for fisheries. Proper water management should try to realise these conditions to the extent to which this is possible.

4.3. Controlled flooding

During the first phase of CPP, controlled flooding has received much attention. Controlled flooding is realised by allowing water in from outside the Compartment during periods when outside water levels are high enough. The need to apply controlled flooding is greatest during the pre-monsoon. During that season, beels need water to stimulate the spawning of fish. Farmers may need extra water for the early wetting of their fields.

It is also obvious that during the monsoon, when there is a general excess of water, there is little need to allow water in. However, during dry years, the intake of water may be beneficial also during the monsoon.

During the first phase, benefits of controlled flooding were considered to be :

Stimulating spawning of fish in beels and other open water bodies.
The water carries silt, which improves the fertility of the fields.
Controlled flooding allows early wetting of fields, when that is desirable.

With respect to the effect of silt on the fertility of the fields, CPP has not been able to monitor that during its first phase. While stating that, it is realised that measuring amounts of silt moving into the Compartment, is a difficult task. For that reason, a definite choice has to be made regarding the decision to go ahead with this measurement or not.

This also applies to the early wetting of fields. So far, wetting of fields during the pre-monsoon has not been monitored and there is no clear insight whether it is advantageous and whether land users consider it as such.

Three additional comments are in place with respect to controlled flooding:

A. It should be realised that only part of the Compartment can profit from controlled flooding. In many cases, there are no inlets at the peripheral border of the compartment. There is also doubt about the capacity of some inlets to flood large areas.
B. If the flooding of higher lands is not well controlled, excess water may go to lower lands and cause damage. Around controlled flooding, procedures and indicators need to be developed to assure that it answers its objectives.
C. Allowing quick increases in water level to happen in beels for spawning, requires that the beel has a more or less direct access to outside water. In many cases this is not so. Furthermore, high water levels in beels affect drainage conditions in upstream chawks. There is insufficient understanding whether the practice is for the benefit of all.

The proposal for the CPP's Final Phase is that controlled flooding should be given less emphasis than during the first phase. Whether controlled flooding is advantageous or not may have to be assessed case by case. The same applies to the filling of beels. If in cases controlled flooding is practised, there should be enough safeguards for surrounding lands.

5. ELEMENTS OF INFRASTRUCTURE

5.1. Water infrastructure

The water infrastructure of the Tangail Compartment consists of three major elements and a large number of small ones. The large elements are: the embankment which surrounds the Compartment partially, the Main Regulator and the Lohajang river. The small elements have been divided into peripheral infrastructure, infrastructure along the Lohajang and internal infrastructure. The peripheral infrastructure consists of water inlets in the embankment, along the outer boundaries of the Compartment. The structures along the Lohajang control the inflow and outflow between sub-compartments and the river. The internal infrastructure consists of structures controlling the water within the sub-compartments. Figure 5.1 shows the peripheral infrastructure and the structures along the Lohajang. The internal infrastructure is shown in the figures 5.2A-D.

5.2. The embankment of the Compartment

As far as water management is concerned, there are almost no operational aspects related to the embankment of the Compartment. The main issues concern its maintenance. Maintenance of the embankment will not be discussed here. It is part of chapter 10 (Institutional Issues) in this Annex.

5.3. The Main Regulator

After the construction of the Main Regulator, water levels in the upstream areas became higher than before (the non-embankment situation), because of backing up effects. CPP has responded to that by formulating mitigation measures to reduce the impacts of the back up effects as much as possible.

Part of the mitigation measures, however, can be found in the operation of the regulator. So far, little is known about its operation rules and the criteria on which the rules should be based. Furthermore, it is a matter of urgency that CPP obtains control of the regulator.

A better understanding is required about the behaviour of water levels around the Compartment. Ways to analyse the available data have already been discussed in the previous chapter.

Next, it is essential that more is known about the hydraulic behaviour of the Lohajang.

5.4. The Lohajang river

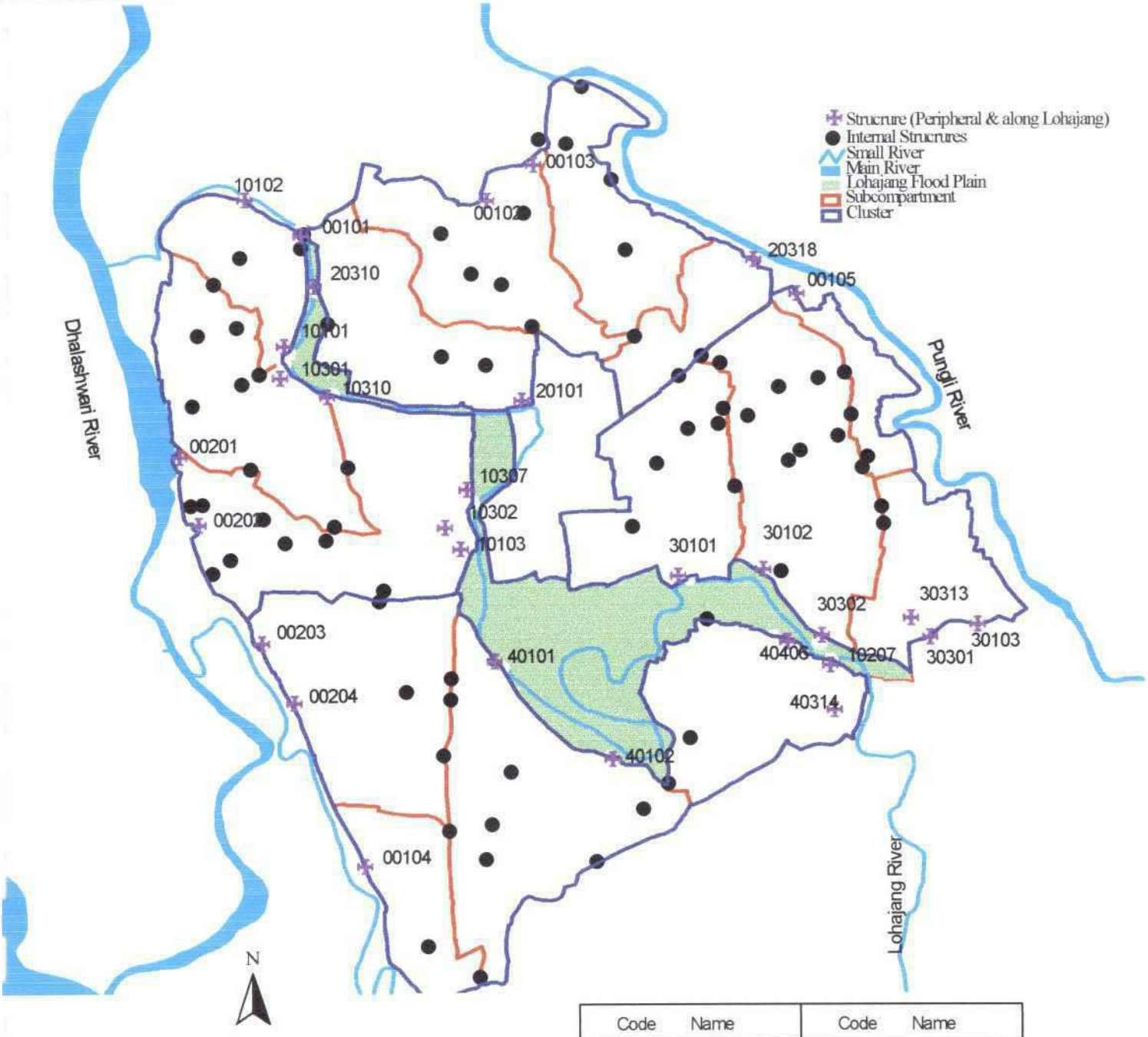
When the Main Regulator is open, levels in the Lohajang may be high and the outlets may act as inlet structures. In the past, high discharges through the Main Regulator have caused serious scouring downstream of the structure. At present there is a sand bar in the river downstream of the Main Regulator which obstructs the flow. The impact of the sand bar on the hydraulic behaviour of the compartment will have to be studied

The hydraulic behaviour of the Lohajang river should be better known. Elements of importance are:

* Relation between upstream and downstream water levels at the Main Regulator, gate settings and the discharges associated with those.
* Water levels in the river and the relation between these water levels and the discharge capacity of the outlet structures.
* Water levels in the river and its discharge under different water levels at the location where the river leaves the Compartment.

Analysis of the behaviour of the Lohajang under different conditions is as important as the analysis of the operation of the Main Regulator and, of course, both studies are related. The proposal is that these studies will be done within six months after the finalising of the Inception Report.

Fig 5.1 Peripheral infrastructure & structure along the Lohajang



Code	Name	Code	Name
00101	Lohajang Main Inlet	10310	Chillabari CDO
00102	Sadullapur Regulator	20101	District Regulator
00103	Rasulpur Inlet	20310	Dharerbari WCS
00105	Suruuj Inlet	30101	Jalfai Outlet
00201	Binnafair Sluice	30102	Bhatkura Outlet
00202	Fatehpur sluice	30103	Paschimauli Regulator
00203	Indrobelta Sluice	30301	Karatia WCS
10101	Dithpur Outlet	30302	Khdirapur WCS
10102	Khorda Jugini Inlet	30313	Karatia Chow. WCS
00104	Baruha Inlet	40101	Aloaraypara Regulator
10103	Kagmari Outlet	40102	Deojan Regulator
10301	Dannya Chow. CDO	40314	Birpusia WCS
10302	Digulia-1 CDO	40406	Kumuli GPC
10307	Digulia-2 CDO	40407	Khagjana GPS
00204	Barabelta Sluice	20318	Bararia Sluice

5.5. Peripheral infrastructure

Along its perepheral boundary the Compartment has inlets, which may also serve as outlets if water conditions allow. The inlets are located on the levees of rivers. That gives them a topographically higher position, which is a constraint for their functioning as outlet. All peripheral inlets have been listed in Table 5.1. Including the Main Regulator, there are 11 inlets.

5.6. Infrastructure along the Lohajang river

Because water levels in the Lohajang can be manipulated at the Main Regulator, the river functions as a drain for the Compartment. Along the river there are 18 outlets have been constructed, with details as given in Table 5.1.

Table 5.2, the fourth column, gives the design levels at which the Lohajang is to be maintained during the monsoon. Early after the completion of the Main Regulator, water levels in the Lohajang downstream of the structure, were maintained at 11 m +PWD, i.e. 1 m above the levels in Table 5.2. However, in order to allow drainage in the southern parts of the Compartment, design water level were lowered to 10 m +PWD.

5.7. The internal infrastructure

The internal infrastructure of the Tangail Compartment consists of regulators, Water Control Structures (WCS), Controlled Drainage Outlets (CDO), gated pipe culverts (GPC) and khals. All regulators, WCSs, CDOs and GPCs have gates and the water can be controlled. A number of structures is small and of local importance only.

CPP's construction programme has not been finalised yet. So not all structures, originally planned, have been built. In addition during the course of the Project, structures have been removed from the planning and new structures have been introduced.

Efforts should be made and are already made that CPP's data base is in accordance with the field situation. The figures 5.2.A-D, together with the tables 5.1-5.3, provide a summary of the current situation.

Besides the construction of structures and the excavation of khals, with an important role in the water infrastructure, CPP has done other construction jobs of less importance for water management. Those are bridges, minor culverts etc. A considerable re-sectioning was done of the embankments surrounding the Compartment. Those works will not be discussed here, as they are not essential for operational purposes. Their maintenance, however, responsibilities and financing will be discussed in Chapter 10.

The figures 5.2A-D mainly show the khals which have been re-excavated by CPP. Insufficient knowledge exists about their hydraulic properties. Similar to the structure database, the khals will also be included.

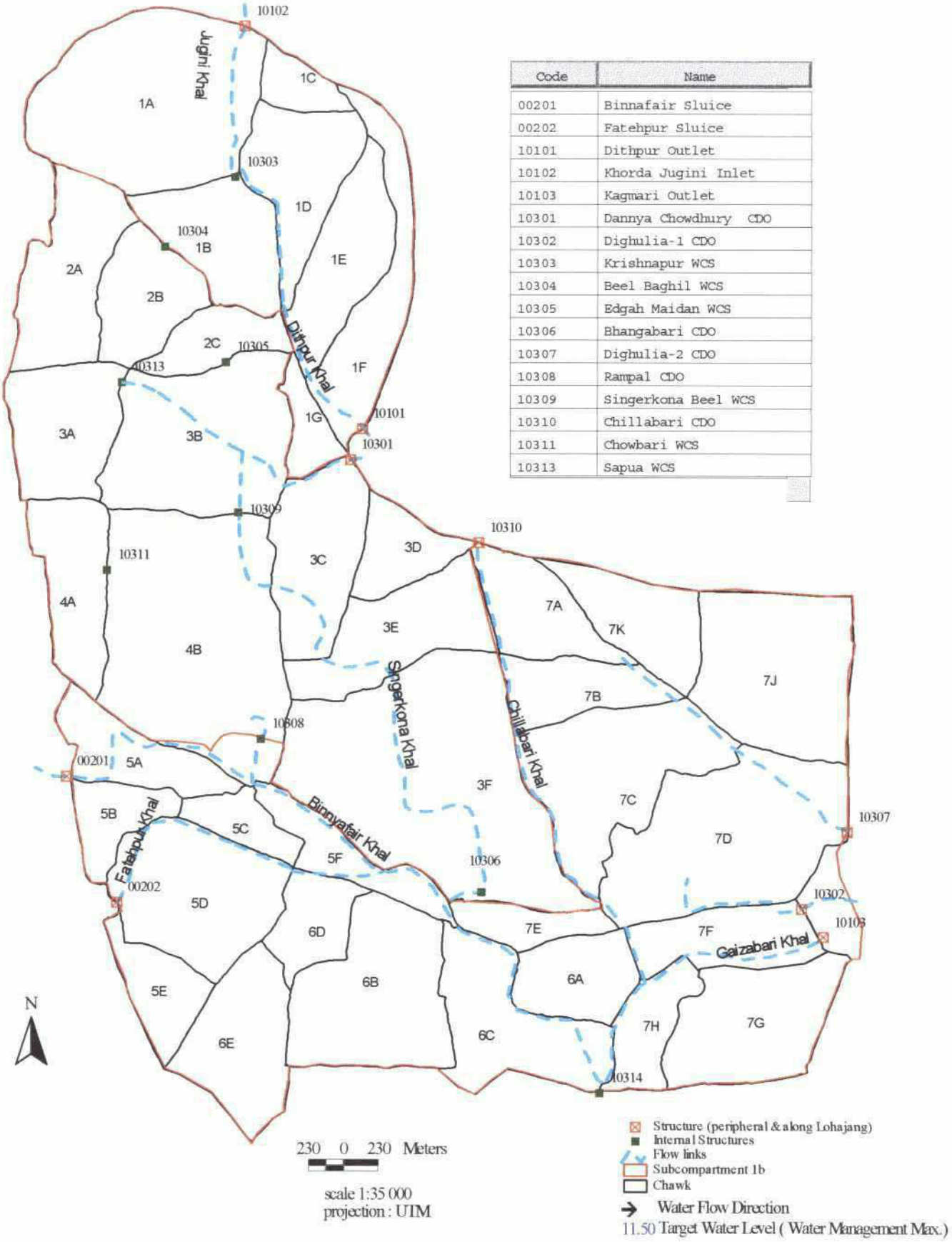
Table 5.1: Peripheral inlet structures, CPP

	ELANJANI RIVER		No of vents	Dimension of gates (H x V)	Sill level + PWD
1	Baruha		1	1.25 x 1.75 m	9.70
2	Bara belta		1	0.95 x 1.15 m	9.75
3	Indra belta		1	0.90 x 1.25 m	9.62
	DHALESWARI RIVER				
4	Fatehpur		1	0.90 x 1.20 m	8.84
5	Binnafair		1	0.90 x 1.20 m	8.84
	LOHAJANG				
6	Khurda jugini		1	1.50 x 2.50 m	10.00
7	Main regulator		2	1.50 x 2.30 m	9.20
			3	3.00 x 3.80 m	10.70
	GALA RIVER				
8	Sadullapur		1	3.00 x 3.00 m	9.20
9	Rasulpur		1	1.50 x 3.0 m	9.20
	PUNGLI RIVER				
10	Bararia		1	0.90 m diam	10.75
11	Suruj		1	1.50 x 3.00 m	9.20

Table 5.2: Structures along the Lohajang-river, CPP

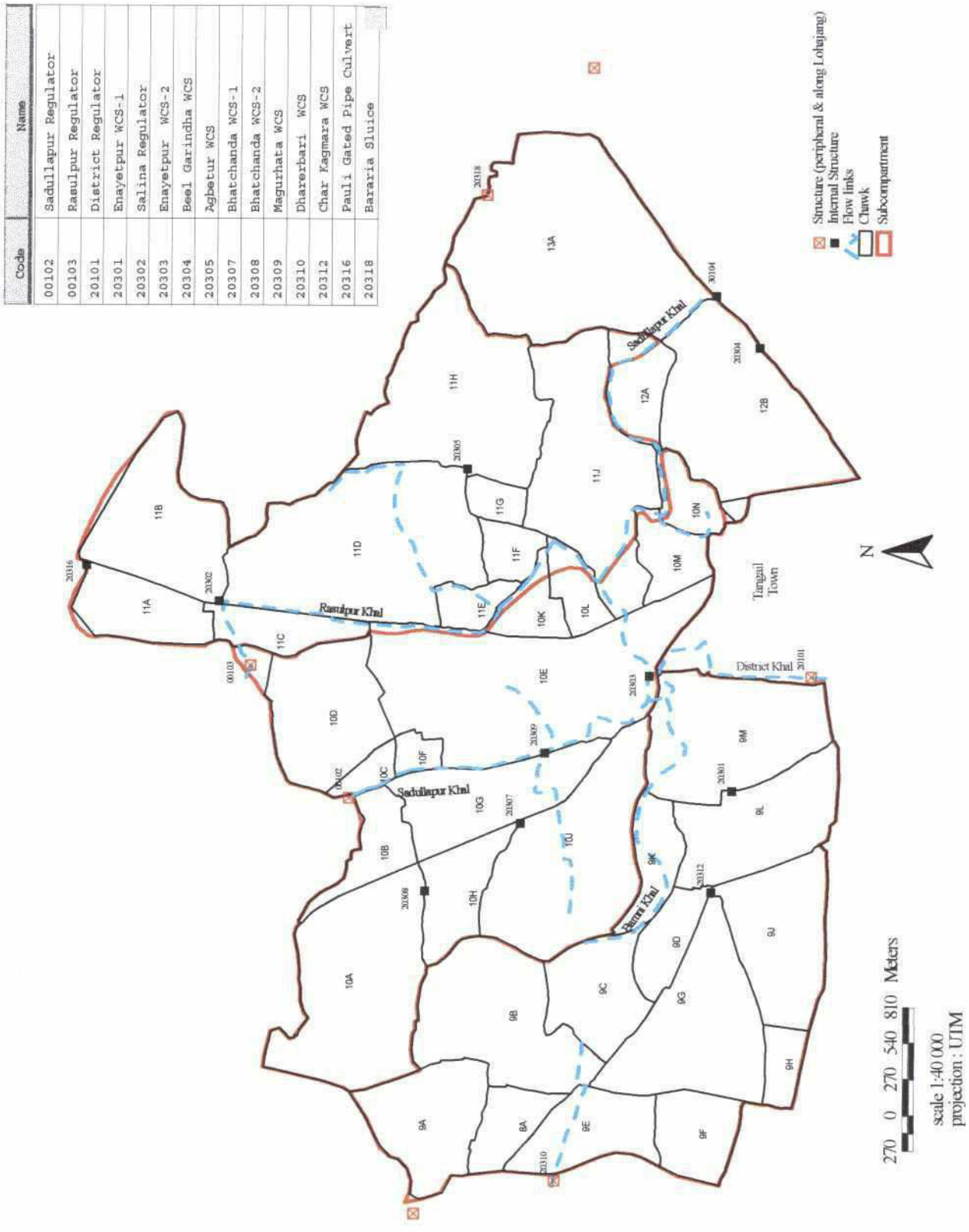
	Sub-Com-partment	Name	Design level Lohanjang +PWD	Number of Vents	Dimensions of Vents (m x m)	Sill level +PWD
1	9	Dithpur	10.00	2	2.00 x 1.00 m	10.90
				1	0.90 x 0.90 m	9.45
2	10	Dannya Chowdhury	10.00	1	0.90 m diam	8.70
3	11	Chillabari	10.00	1	0.90 m diam	8.10
4	11	Dighulia1	9.90	1	0.90 m diam	8.50
	11	Dighulia2	9.90	1	0.90 m diam	8.00
5	11	Kagmari	9.90	2	1.50 x 3.00 m	7.80
6	14	Aloha Raypara	9.65	4	1.50 x 3.00 m	7.20
7	14	Deojan	9.50	1	2.50 x 4.80 m	8.20
8	15	Kumulli	9.00	1	0.75 m diam	8.60
9	15	Fusukia (Khagjana)	9.00	1	0.75 m diam	8.00
10	15	Birpushia	9.00	1	1.50 x 1.80 m	8.50
11	8	Dharerbari	10.00	1	0.90 x 1.20 m	10.00
12	8	District	9.90	2	1.5 x 3.0 m	8.00
13	4	Nagar Jalfai	9.00	2	1.50 x 3.00 m	6.50
14	3	Bhatkura	9.00	2	1.50 x 3.00 m	7.00
15	3	Khudirampur	9.00	1	1.50 x 1.80 m	8.00
16	2	Karatia Chowdhury Para	9.00	1	0.90 x 1.20 m	8.00
17	2	Karatia	9.00	1	1.20 x 1.50 m	7.50
18	2	Paschim Pauli	9.00	1	1.20 x 1.50 m	7.50

Fig 5.2.A Internal Infrastructure Cluster1b, with old Sub-compartment boundaries



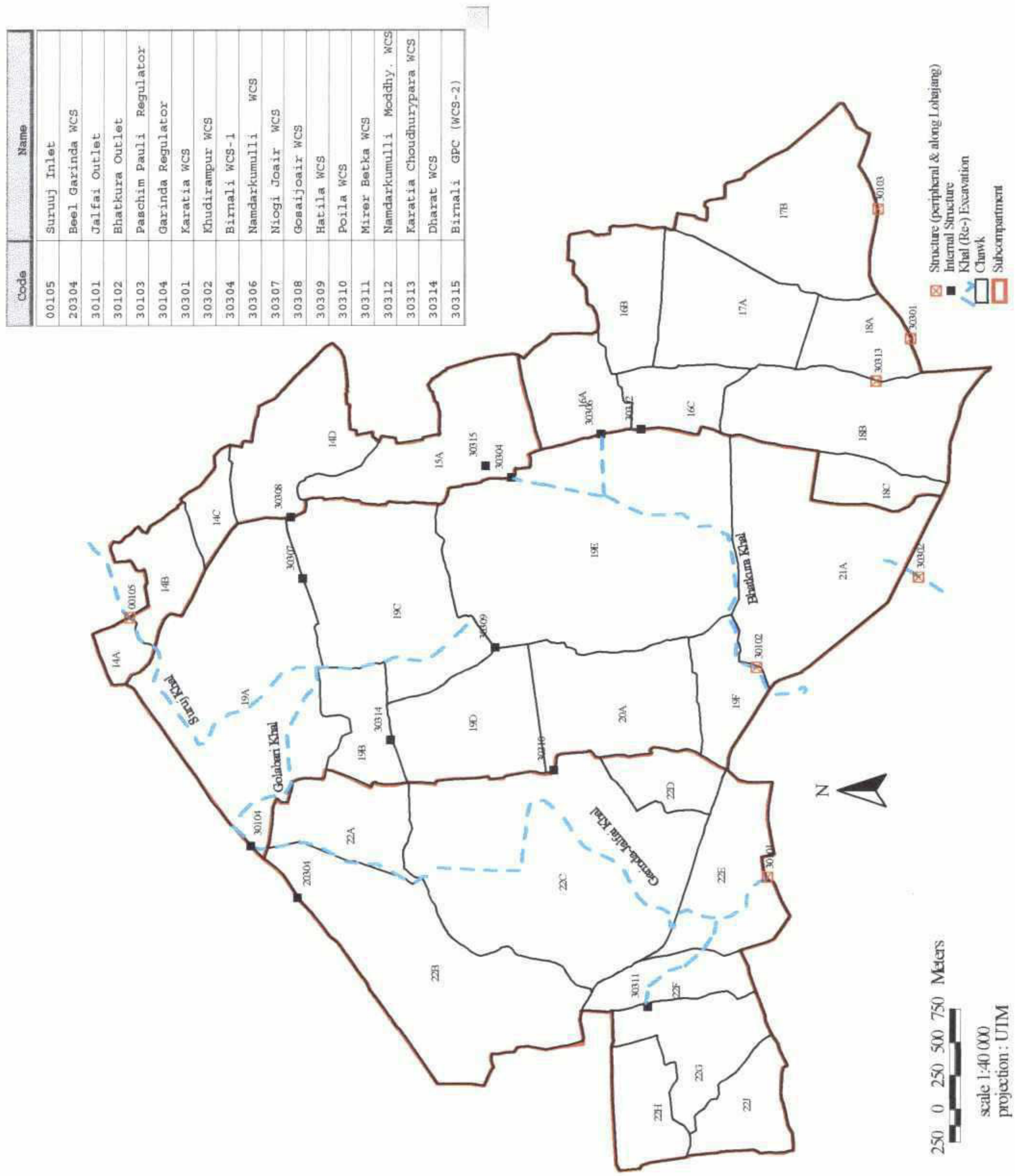
Code	Name
00201	Binnafair Sluice
00202	Fatehpur Sluice
10101	Dithpur Outlet
10102	Khorda Jugini Inlet
10103	Kagmari Outlet
10301	Dannya Chowdhury CDO
10302	Dighulia-1 CDO
10303	Krishnapur WCS
10304	Beel Baghil WCS
10305	Edgah Maidan WCS
10306	Bhangabari CDO
10307	Dighulia-2 CDO
10308	Rampal CDO
10309	Singerkona Beel WCS
10310	Chillabari CDO
10311	Chowbari WCS
10313	Sapua WCS

Fig 5.2.B Internal Infrastructure Cluster2 with old sub-compartment boundaries



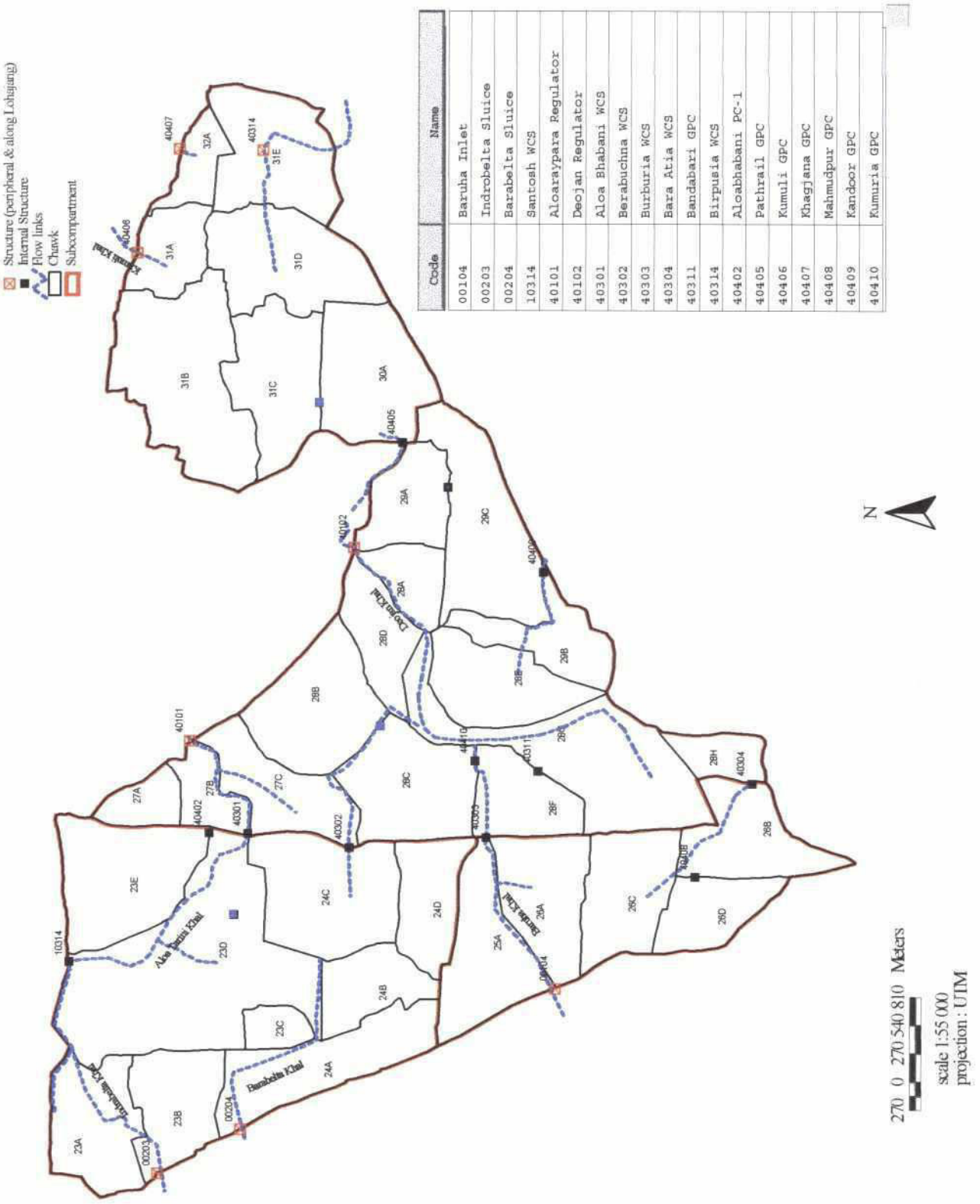
Compartmentalization Pilot Project Tangail

Fig 5.2.C Internal infrastructure Cluster3 with old Sub-compartment boundaries



Code	Name
00105	Suruuj Inlet
20304	Beel Garinda WCS
30101	Jalfai Outlet
30102	Bhatkura Outlet
30103	Paschim Pauli Regulator
30104	Garinda Regulator
30301	Karatia WCS
30302	Khudirampur WCS
30304	Birnali WCS-1
30306	Namdarkumulli WCS
30307	Niogi Joair WCS
30308	Gosaijoair WCS
30309	Hatila WCS
30310	Poila WCS
30311	Mirer Betka WCS
30312	Namdarkumulli Moddhy. WCS
30313	Karatia Choudhurypara WCS
30314	Dharat WCS
30315	Birnali GPC (WCS-2)

Fig 5.2.D Internal infrastructure Cluster4 with old sub-compartment boundaries



Compartmentalization Pilot Project Tangali

Table 5.3: Internal infrastructure of the Tangail compartment

	Name of Structure	Number of Vents	Dimensions of gates	Sill Level + PWD
CLUSTER 1 (Fig 5.2A)				
1	Krishnapur	1	1.50 x 1.80 m	9.75
2	Beel Baghil	1	0.60 m diam	8.70
3	Edgah Maidan	1	0.90 x 1.20 m	10.20
4	Sapua	1	0.60 m diam	9.60
5	Singerkona Beel	1	1.50 x 1.80 m	8.75
6	Chowbari	1	0.60 m diam	9.50
7	Rampal	1	1.50 x 1.80 m	9.00
8	Sarutia		Not Implemented	
9	Bhangbari	2	1.50 x 1.80 m	8.60
10	Santosh	3	1.50 x 2.00 m	8.00
CLUSTER 2 (Fig 5.2B)				
1	Salina	1	0.90 x 1.20 m	9.00
2	Batchanda1	1	1.20 x 1.50 m	9.00
3	Batchanda2	1	0.90 x 1.20 m	9.50
4	Magurhata	1	1.50 x 1.80 m	9.00
5	Agbetur	2	1.50 x 1.80 m	8.50
6	Beel Garinda	1	1.50 x 1.80 m	8.00
7	Enyatpur Regulator	1	2.50 x 2.00 m	9.00
8	Enyatpur WCS	1	2.00 x 2.50 m	8.00
9	Dariabari	Details unknown		9.00
10	Char Kagmara	1	1.20 x 1.50 m	9.50
11	Bashar Char	Details unknown		10.50
12	Garinda Regulator	2	1.80 x 3.50 m	7.00
CLUSTER 3 (Fig 5.2C)				
1	Gosaijoair (Atapara)	1	1.20 x 1.50 m	8.50
2	Birnali1	1	0.90 m diam	7.00
3	Namdarkumulli	1	0.90 x 1.20 m	8.50
4	Niogi Joair	1	0.90 x 1.20 m	8.50
5	Gosaijoair	1	1.20 x 1.50 m	8.00
6	Hatila	1	1.20 x 1.50 m	8.00
7	Poila	1	2.50 x 1.50 m	8.50
8	Mirer Betka	1	0.90 x 1.20 m	8.00
9	Namdarkumulli	1	1.20 x 1.50 m	8.50
	Moddhyapara			
10	Dharat	1	0.6 m diam	9.00
11	Birnali2	1	0.6 m diam	8.00
CLUSTER 4 (Fig 5.2D)				
1	Pathrail	1	0.75 m diam	8.60
2	Bhurbhuria	2	1.50 x 1.80 m	8.60
3	Aloa Bhabani1	1	0.75 m diam	8.60
4	Aloa Bhabani2	1	0.75 m diam	8.00
5	Bera Buchna		Details unknown	
6	Kumuria		Gated Pipe Culvert	
7	Banda Bari		Gated Pipe Culvert	
8	Mahmudpur	1	0.75 m diam	10.00
9	Bara Atia	2	1.50 x 1.80 m	9.00
10	Kandor	1	0.9 m diam	8.50
11	Birpushia	1	1.50 x 1.80 m	8.50

6. INFRASTRUCTURE PER CLUSTER

6.1. Infrastructure in Cluster 1b

6.1.1. Water intake

Figures 5.2A-D do not show beels. Where beels occur and where they may be given a water transport function, they have been drawn as khals.

Figure 5.2A shows the main water infrastructure in Cluster 1b. The concept is rather simple: all khals are connected to an outlet on the Lohajang river. Most khals are connected to an inlet. There are three inlets: Khurda Jugini, Binnyafair and Fatehpur. It is clear that the north-western part of the cluster does not have easy access to water from the outside, because there are no inlets. In the same way, the areas to the east depend on water inlets along the Lohajang.

Water levels in the Lohajang, in the Northwest, outside the Compartment, have been measured in Ramdevpur (Gauge G35) since May 1993. The average levels of May, June and July are as shown in Table 6.1. Only during the year 1993 records have been collected in May. In the same way water levels in the Lohajang are known.

Table 6.1: Average water levels at Ramdevpur (gauge G35)

Year	Month	Average waterlevel (+PWD)
1993	May	8.87 m
	June	9.88
	July (1-15)	11.03
1994	May	No Data
	June	9.99
	July (1-15)	10.21
1995	May	No Data
	June	9.76
	July (1-15)	11.58
1996	May	No Data
	June	9.24
	July (1-15)	11.05

With the sill levels, the sizes of the openings and the outside water levels known, the amounts of water have been calculated which could have been taken in during the different years. In the calculation a flow velocity of 0.5 m/s was assumed.

The calculations were done for the full months of June and the first half of July. This is in conformity with CPP's operation rule during the first phase of the Project, that inlets are left open until July 15.

It appears from the calculations that during all years ample water could have been taken in. Calculated as a water layer over the full area of 2,500 ha of the cluster, the water intake per year was about 1.0 m or more.

However, not Khurda Jugini but Kagmari is the dominant inlet, providing about half of the total water. Binnyafair and Fatehpur together provide about 20%, Jugini less than 10%. So there is a clear problem of water distribution. The south has abundant supplies, while the north may experience shortages.

In order to trigger spawning of beel resident fish, a water layer of 1-1.5 m has to added to the beel areas during pre-monsoon. It appears that the possibilities for water intake satisfy these criteria as far as quantity is concerned. There is a problem, however, moving the water from the south to the northern beels.

The amounts are also abundant if farmers want to pre-irrigate their fields before the rains. The main problem is likely to be the control of the water. Water intake should not go at the expense of the lower fields, which may receive excess water.

6.1.2. Drainage capacity

The cross section of all drainage structures discharging into the Lohajang river, not counting Santosh, is about 15 m^2. Calculating with an average flow velocity of 0.5 m/s, the drainage capacity is about 7.5 m^3/s or 25 mm/24 hours. This should be sufficient for the area. Water systems in the Compartment have a great storage and drainage is slow.

The criteria which were used in the capacity calculations of the drainage structures need to be checked. Some assumptions seem to be unrealistic. It is important that CPP develops a consistent set of design criteria for structures.

6.1.3. Spilling at Santosh

In the southern boundary of Cluster 1b, the Santosh regulator is located at the boundary with Cluster iv. Dimensions of the gates of the structure are given in Table 5.3. The main khals of the sub-compartments 10 and 11 lead to Santosh. The drainage capacity of the structure is estimated at about 5 m^3/s.

If Santosh is to be operated frequently, it puts the compartmentalization concept to discussion. Compartmentalization intends to prevent the accumulation of excess water in low areas. As it appears from the previous paragraphs, there is sufficient drainage capacity along the western bank of the Lohajang in the cluster.

In the road along the southern boundary of Cluster 1b, there are several bridges. Some of the bridges have been closed by CPP, but at least one bridge, and one of a considerable span, is still open towards the south. This is one of the compromises made during the first phase.

During CPP's Final Phase, the water management approach should be to operate Santosh as little as possible and drain cluster 1 towards the Lohajang. Closing the bridge mentioned in the previous section to prevent water from flowing south should only be discussed if SCWMCs ask for it.

6.2. Infrastructure in Cluster 2

6.2.1. General

The water system of Cluster 2 has two inlets in the north, Rasulpur and Sadullapur and one outlet on the Lohajang, the District Regulator. The cluster also has an outlet towards Cluster 3 at Garinda. In the same way as the Santosh Regulator, operating the outlet towards Cluster 3 is against the compartmentalization concept.

On the other hand there is no good alternative for the drainage of the eastern half of the cluster. Between the area and the Lohajang lies Tangail town and draining through the urban area is not advisable. An alternative would be to close the southern branch of the Sadullapur Khal, such that the water from the east moves to Enayetpur and the District regulator. At the same time the capacity of the system towards the District regulator and the regulator itself needs to be enlarged. Such changes require renewed planning. The matter is related to the reorganisation of the sub-compartments and will be further discussed there.

The major khals run from the inlets to the two outlets. In fact one may say that the western part of the cluster, at least part of it, drains via the District Regulator and the eastern part via Garinda. By operating the Enyatpur Regulator one has the possibility to divert water from the west to the east when Enyatpur is open. When it is closed both parts drain more or less independently.

6.2.2. Water intake

Cluster 2 may take water in via the Sadullapur, Rasulpur and Bararia inlets. Along the Lohajang there are Dharerbari and District Regulator. The Tables 5.1 and 5.2 show sill levels of the structures. Table 6.2 shows average water levels at Gauge 28, Gala Khal. Before the dates indicated, no water levels are available.

Table 6.2: Average water level at Rasulpur (gauge 28, Gala khal)

Year	Month	Average water level (+PWD)
1992	June (23/6-30/6)	9.84 m
	July (1/7-15/7)	10.26
1993	June (17/6-30/6)	10.07
	July (1/7-15/7)	10.85
1994	June (5/6-30/6)	9.68
	July (1/7-15/7)	9.84
1995	June (20/6-30/6)	9.03
	July (1/7-15/7)	10.60
1996	June (6/6-30/6)	9.11
	July (1/7-15/7)	10.40

The amounts of water taken in by the inlets were calculated in the same way as before. Due to lack of data, the water intake during June is questionable. The amounts of water taken during the first half of July is low. Calculated over the full area of 2,600 ha they are between 20 and 25 cm in most years. In 1994 they are about 15 cm.

The District regulator and Sadullapur provide most of the water, each 45% of the total. Rasulpur takes 10%, while Dharerbari and Bararia are insignificant.

The conclusion is that conditions for water intake are less in Cluster 2 than in Cluster 1b.

6.2.3. Drainage capacity

The District Regulator is about the only structure in the cluster with an appreciable drainage capacity. Its maximum is about 3-4 m^3/s or 10-12 mm/24 hrs calculated over the full area of 2,600 ha. This is rather low and the structure may be a constraint during heavy rain.

The second drainage structure is Garinda, at the boundary between Cluster 2 and 3. As already mentioned, its function goes against the principles of compartmentalization. Garinda Regulator has a drainage capacity of about 10 mm/24 hrs (3 m^3/s), calculated over the full area of the cluster. So the District regulator and Garinda together have a capacity of about 20 mm/24 hrs, which is less than is available in Cluster 1b.

Garinda Regulator has not been implemented yet. Similar to the Santosh situation, also the eastern boundary of Cluster 2 is far from water tight.

Although there is a possibility to divert water from the western part of the cluster to the eastern part, for all practical purposes one may assume that the District regulator drains the western half and Garinda the east. For both halves drainage conditions are less favourable than those in Cluster 1. In addition the eastern part of Cluster 2 drains at the expense of Cluster 3.

If drainage capacity appears to be a constraint, the solution would be to expand the capacity of the District regulator, while trying to divert as much water as possible from the east towards it. The matter is also related to the reorganisation of sub-compartments and will be further discussed there.

6.3. Infrastructure in Cluster 3

6.3.1. Water intake

The potential for water intake from the Pungli river is limited in Cluster 3. The only inlet is Suruj, which has a maximum capacity of about 1 m^3/s. Other possible inlets are located along the Lohajang namely Nagar Nalfai, Bhatkura and Khudirampur. Sill levels of the three structures have been given in Table 5.2.

Average water levels in the Lohajang measured at Karatia (Gauge 8) have been presented in Table 6.3. From these data it appears that the possibilities for water intake during May are marginal. During June and July substantial amounts of water may be taken in by the cluster, exceeding 0.5 m, calculated as a water layer over the full area of 2,700 ha. Nagar Jalfai and Bhatkura are dominant, accounting for about 90% of the water.

Table 6.3: Average water levels at Karatia (gauge 8, Lohajang)

Year	Month	Average water level (+PWD)
1991	May 14 - 31	7.14
	June 1 - 30	8.44
	July 1-15	9.59
1992	June 29 -30	8.74
	July 1 -15	9.07
1993	May 8 - 31	6.80
	June 1 - 30	7.80
	July 1 - 15	8.93
1994	June 22 - 30	7.98
	July 1 - 15	8.06
1995	June 19 - 30	8.14
	July 1 - 15	8.73
1996	June 1 - 30	6.89
	July 1 -15	8.19

6.3.2. Drainage capacity

As may be expected from the dimensions of the structures on the Lohajang, the drainage capacity of the cluster is about 30 mm/24 hrs (9.5 m^3/s), which is sufficient. In this statement, the drainage capacity available along the southern border of the cluster, which is also the boundary of the Compartment, has not been taken into account. So the actual drainage capacity is even larger.

What should be taken into account, however, is that Cluster 2 may spill into Cluster 3 during periods of heavy rain, at a rate of about 3 m^3/s. So about one third of the available capacity is taken up by the drainage of the upstream areas. This makes the drainage situation tighter than desirable.

The fact that Cluster 2 needs to drain partially via Cluster 3 makes it necessary that the khal system of Cluster 3 has sufficient capacity to carry the water in a way that no damage is done. There is a khal between Garinda and Nagar Jalfai, which has been rehabilitated by CPP. Hydraulic properties of the khal need to be taken up in the Project database.

6.3.3. Boundary conditions in the south

One should realise that conditions along the southern boundary of the Compartment are largely unknown. As can be concluded from Table 5.2, both drainage outlets there, Paschim Pauli and Karatia, have rather large capacities. It would be in concordance with the compartmentalization concept if the two outlets would remain closed as much as possible. The Compartment should not bother its neighbours with its drainage problems.

6.4. Infrastructure in Cluster 4

6.4.1. Water intake

Cluster 4 has three water intakes along its western boundary: Indra Belta, Bara Belta and Baruha. Sill levels of all three are at about 9.7 +m PWD. Average water levels in the Elanjani (Gauge G12, Goziabari) are shown in Table 6.4.

Table 6.4: Average water levels in the Elanjani (Goziabari, gauge G12)

Year	Month	Average water level (+PWD)
1991	June	9.27
	July	10.66
1992	June	7.09
	July	9.15
1993	June	9.41
	July	10.78
1994	June	8.40
	July	8.77
1995	June	8.00
	July	10.03
1996	June	6.88
	July	9.63

It appears that in none of the months of June during the years 1991-1996, water could be taken in. In July water intake was possible during the years 1991, 1993 and 1995 I. e. e about 1 out of 2 years. During the years 1991 and 1993, the potential for water intake was limited and amounted to a water layer of about 5 cm over the total area of 3,500 ha. During 1995 it was even less, about one third of the other years.

With the water intake from the Elanjani being marginal, the alternative is, taking in water from the Lohajang during the pre-monsoon. There are four potential intakes on the Lohajang, Aloa Raypara, Deojan, Kumulli and Khagjana. The largest one is Aloa Raypara, both because of the size of its vents and because of its low sill level.

The water that can be taken in from these inlets, during June and July differs per year. However, in most years it exceeds 0.25 m, calculated as a water layer over the whole area of 3,500 ha. Only in 1996 it was only 0.10m.

One may conclude that the possibilities for water intake are greater from the Lohajang than from the Elanjani. The structure Aloa Raypara is dominant.

6.4.2. Drainage capacity

With respect to drainage, also here the structure Aloa Raypara is dominant. However, the structure was designed to accommodate spill from Santosh as well. Aloa Raypara together with Deojan have a drainage capacity of 35 mm/24 hrs or 15 m^3/s. If Santosh would spill 5 m^3/s, the spilling requires one third of the capacity. In that case the drainage capacity of the cluster may become problematic. Also in Cluster 4, conditions along the boundary with the outer area are largely unknown.

7. WATER MANAGEMENT

7.1. Current priorities in water management

During its first phase, CPP has defined target water levels per season and per chawk, based on the dominant land use in the chawk. Fig 7.1 shows an example of proposed water levels in the chawks of Cluster 1b at the end of the monsoon (October 16-November 15). The figure also shows the structures, which supposedly are the most important to control water levels.

Two remarks can be made with respect to the targets levels :

Differences in water levels between adjacent chawks are so small that one may wonder whether they can be maintained under conditions of porous embankments, i.e. embankments with many culverts, small bridges, cuts, etc.
The picture shows a cascade of water levels. Where level differences between two adjacent chawks occur, an arrow has been drawn indicating the direction of flow. Where there are structures controlling the flow, they have been indicated as well. As there are so many chawk boundaries across which flow occurs, one may wonder whether the structures control the water movement or whether the porous water boundaries partially determine the flow.

In the meantime additional inquiries have revealed that the internal infrastructure is indeed less used than anticipated during the first phase of CPP. Land users are also interested in drainage facilities, the excavation of khals, and less in the operation of structures. That means that during CPP's Final Phase, water management targets have to be redefined.

7.2. New priorities

Consequently the following reorientation in targets is proposed:

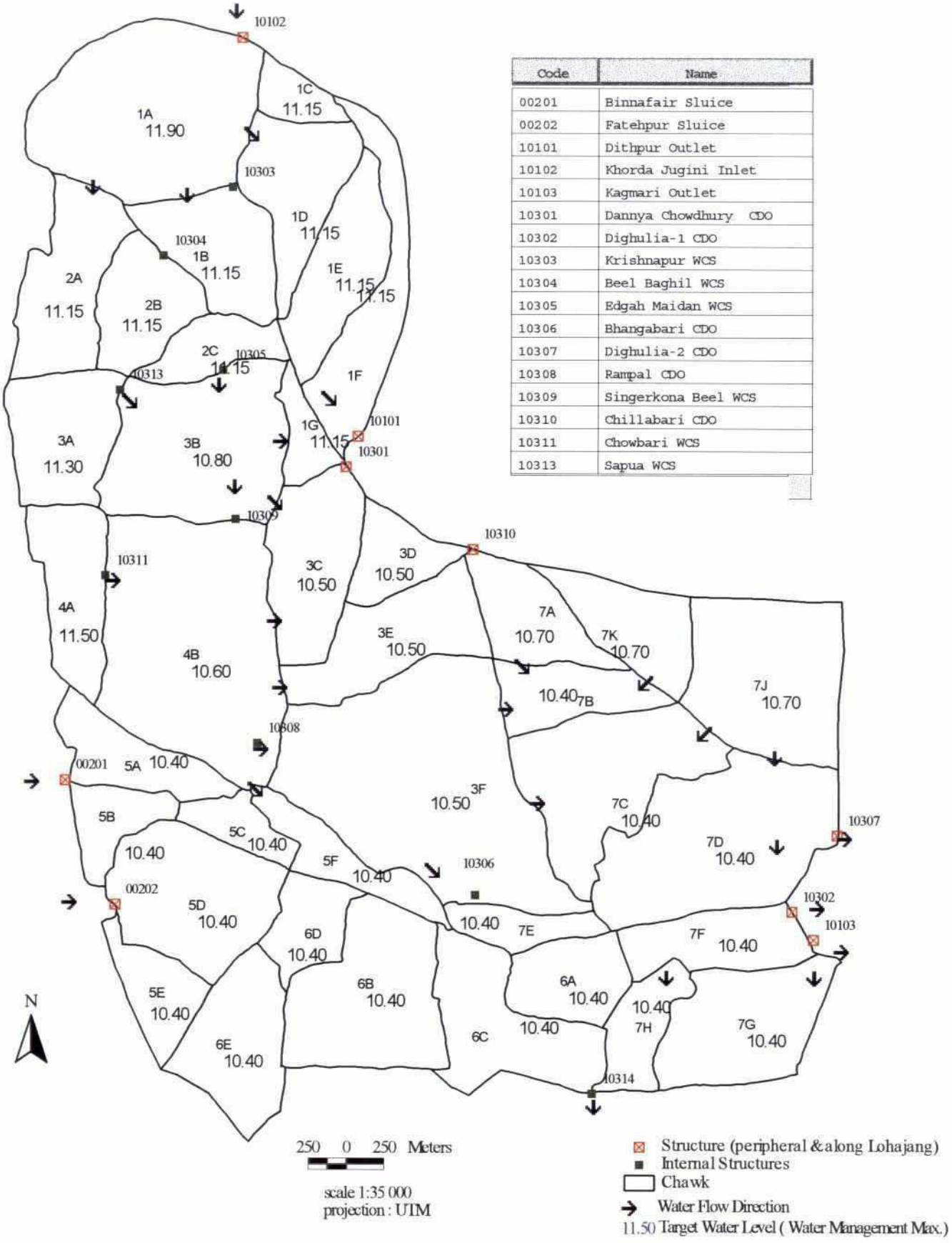
A renewed emphasis on drainage and the management of drainage water. It is needed in addition to the controlled flooding and water intake. This implies that the management of drainage systems needs to be simplified. One way is to reorganise sub-compartments in such a way that drainage systems are contained within one sub-compartment. This prevents that more than one SCWMC becomes involved with the management of a drainage system. Proposals have been formulated in Appendix 1 of this Annex.

There will be less emphasis on controlled flooding and the intake of water. This does not mean that intake of water will not be done. However, it will be considered of secondary importance, while circumstances should be favourable. For instance, a condition could be that there should be a water inlet at relatively close distance.

Also a decentralisation of water management is required. From Appendix 1 and the previous chapter, it becomes clear that circumstances per sub-compartment, may differ considerably. For instance, it is not possible, to state that all perennial beels should be filled up with 1 m of water during the pre-monsoon. The desirability of such an activity depends on the distance to an inlet structure, effects on surrounding chawks, property rights in the beels, etc.

The chawks are the proper units to asses such differences of particular settings. The sub compartments are too large for that. However, in order to be able to work at chawk level, CPP needs to establish contacts with the chawks.

Fig 7.1 Example of Water Level Control Cluster1b



Code	Name
00201	Binnafair Sluice
00202	Fatehpur Sluice
10101	Dithpur Outlet
10102	Khorda Jugini Inlet
10103	Kagmari Outlet
10301	Dannya Chowdhury CDO
10302	Dighulia-1 CDO
10303	Krishnapur WCS
10304	Beel Baghil WCS
10305	Edgah Maidan WCS
10306	Bhangabari CDO
10307	Dighulia-2 CDO
10308	Rampal CDO
10309	Singerkona Beel WCS
10310	Chillabari CDO
10311	Chowbari WCS
10313	Sapua WCS

7.3. Implementation of the new priorities

7.3.1. Reorganising sub-compartment boundaries

Appendix 1 and its figures indicate the water management situation in the sub-compartments, with proposals to adapt sub-compartment boundaries in such a way that each drainage system is contained in one sub-compartment. This does away with the need of co-ordination and consultation between SCWMCs with respect to drainage and water management matters. Each SCWMC is master in his own house to a considerable extent.

According to the proposals, sub-compartments may contain more than one drainage system. One could carry the reorganisation one step further and make one sub-compartment per drainage system. In this way one avoids that land users in one drainage system have decision power over drainage systems to which they do not belong.

In **Cluster 1b**, sub-compartment 9 can be maintained. In case it is considered desirable, one could disconnect the Dannya Chowdhury system and join it as an independent system with the Dithpur system, as one sub-compartment.

The two Dighulia systems could be joined as independent systems in one sub-compartment.

The Binnyafair, Fatehpur, Singerkona, Gaizabari system could be made one sub-compartment with one drainage system.

A requirement is that Santosh regulator is operated as little as possible or not at all. More should be known about how much water flows through the southern boundary of cluster 1 to the south. However, no measuring programme is needed for the time being.

In **Cluster 4,** the Indrabelta Aloa Tarini is one system, contained in one sub-compartment. The Baruha Deojan system is another one. In the south of the cluster, there are a number of small independent drainage systems. Organising them into one sub-compartment, probably, does not have great urgency.

Cluster 2 is rather complex. The Bamni and northen Sadullapur system both drain towards Eneyatpur and District regulators. The Sadullapur, however, brings part of its water towards the east, towards the Rasulpur Sadullapur South system. Eneyatpur and District regulators apparently lack capacity to accommodate all of the drainage flow.

Rasulpur Khal and Sadullapur South carry their water over the cluster boundary towards Cluster 3. This is not desirable from the compartmentalization concept, because part of the land there is low, while it interferes with drainage conditions in Tangail Town.

There are a number of options open, all of which require additional construction work. Reference should be made, to the chapter on infrastructure, where it is stated that Cluster 2 is short of drainage capacity. Diverting the water to Cluster 3, however, is likely to create drainage problems there. So as far as drainage capacity is concerned, something needs to be done about the systems in Cluster 2, anyway.

The following options are available:

* To disconnect chawks along the Lohajang from the Bamni Khal to relieve the Eneyatpur and District regulators.
* To separate the Sadullapur-North system from the Rasulpur Sadullapur South system, have them both discharging to the Eneyatpur and District regulator and increase the capacity of the downstream system. In that case the District Khal would fall under joint management of three sub-compartments. Drainage to cluster 3 would be discontinued.

* To make one sub-compartment containing the Rasulpur and Sadullapur systems but disconnect southern Sadullapur join from the rest and join it with Cluster 3.

Reorganising **Cluster 4** is relatively simple again. Garinda-Jalfai can be made into an independent system. It is advisable to disconnect Darun beel from the Tangail drain to prevent interference between the drainage of agricultural land with that of urban area.

The Suruj-Bhatkura system may also be distinguished as an independent system, to which the chawks along the Pungli river can be added. Part of the system in chawk 19E, downstream of Hatila beel, has not yet been identified.

The southern part of the cluster consists of a number of independent, small drainage systems as is the case in the south of Cluster 4.

7.3.2. Decentralisation

There are similarities between water management and agricultural extension. Agricultural Xextension has field workers, one for every 500-1,000 ha. Similarly government services doing water management need decentralised operations.

For CPP to do water management, it needs to decentralise to the sub-compartments and to establish closer relations with the field. It is proposed to establish four field offices, one per cluster, manned by junior water management officers (JWMO). At present, the Project has recruited already 3 JWMO. A tasks description for the JWMO has been provided in Appendix 2.

The JWMO's primary task is water management. However, his role is as much being a facilitator as an engineer. He needs to be employed by the Project, not by a NGO. In addition, he needs a motor cycle, to be able to move around, and additional facilities normal for a field worker. He needs to be trained by the Project for his tasks.

7.4. Manuals and procedures

CPP needs to prepare detailed but concise and practical operational manuals per cluster. Although the cluster is not considered a water management unit, the cluster level is chosen because they are the most independent units, hydrologically speaking. In addition, the next level is the sub-compartment. There are 16 sub-compartments.

The JWMOs need to be trained in those manuals and associated procedures. They in turn train land users at chawk level. The manuals treat only matters related to internal infrastructure. Manuals about the operation of the primary infrastructure, the Main Regulator, etc., will be discussed elsewhere.

The writing of the manuals should be done in a cautious way. First draft manuals are to be prepared, which need to be tested in the field and discussed with the SCWMCs. As the needs appear, manuals are adapted. The JWMO has a task in testing the manuals provide feedback on their usefulness.

7.4.1. Synchronising water level targets

Water level targets of the Project and the land users need to be synchronised. Land users need to understand the operation rules drafted by the Project before they can endorse them and cooperate.

An inventory about opinions at chawk level to be collected by the JWMOs and to be brought together at SCWMC level, would be helpful and opens opportunities to improve the performance of the Project. Disadvantaged chawks may be able to protect themselves making use of minor works facilities.

7.4.2. By-laws and regulations

It is not clear to what extent CPP has succeeded in drafting by-laws and regulations for the SCWMC. Ref 5 requires that SCWMCs, in order to be able to execute minor works, need to be registered with BWDB and need a bank account. If that is the case the SCWMCs need rules to operate under.

CPP should take the lead in drafting by-laws and regulations. Draft texts are available in the country, prepared on other projects. The texts should be discussed with the SCWMCs and there should be a formal agreement between the Project and each SCWMC that those are the rules along which both parties will operate.

7.4.3. Agreements on O&M

The matter of O&M will be further discussed in chapter 10 (Institutional Issues). However, CPP, during its life time, should develop a clear policy with respect to O&M. The Guidelines for Minor Works is a good start.

However, the status of O&M for works of higher order than the minor works needs to be discussed as well. Two points should be made clear:

1. It is not a practical proposition to have O&M of major structures done by land users. Major structures involve concrete and steel works. Skills to maintain them are lacking among farmers.

   There are, however, activities which can be done and which are of great help to keep structures in working order. An example is the greasing of spindles of gates. Out of the budgets of SCWMCs, (they have a bank account, after all), oil, paint, grease, can be purchased and someone could be appointed, preferably the gate operator, by the SCWMC, to be in charge of such minor maintenance.

   A similar approach applies to earth works. In water management, there are many conflicts of interest. Individuals take the right in their own hands and build a cross dam in a khal, cut a road or embankment, etc. One of the aims of water management and a task for the SCWMCs assisted by the Project via the JWMOs, is to get such situations out of a sphere of conflict into a sphere of consultation and cooperation.

   The availability of a budget for minor works can be a great help. But if a land user cuts a road to get rid of excess water in his field, one should try to reach an agreement that he repairs the road again after the main problem has passed. Reaching such an agreement is not primarily between the person and the Project but between the person and his neighbours. The Project facilitates. Water management becomes management of conflicts.

2. The second guideline is that there will not be maintenance of works and structures without a budget (see Chapter 10: Institutional Issues).

8. WATER LEVEL GAUGES

8.1. Gauge readings

Currently, CPP collects data on about 125 gauges in the Compartment. That amounts to about one gauge per 120 ha. The number of gauges is a logical consequence of CPP's original target to control water levels with great accuracy at chawk level.

If CPP softens its targets for water level control, it is clear that the number of gauges, will have to decrease. Appendix 2 contains a proposal in this respect. It should be emphasised that the proposal is not only about reducing the number of gauges but about CPP changing its mind about water management as well. In the past CPP wanted to predict and to control the process. In the future, the land users decide. CPP observes and gives guidance.

Tthere are three kinds of gauges have been installed:
- Historical gauges of which there are 38 in 1996. The earliest gauges (4) were installed in 1991. Their readings have been continued up to 1996.
- Structural gauges, of which there were 28 in 1995 and 89 in 1996. Before 1995, there were no structural gauges. The gauges are attached to structures.
- Water management gauges, of which there were 10 in 1993 up to 1995, but which were discontinued after 1995.

The proposal in Appendix 2 is based on the following considerations.
- The Project would need gauge readings in the rivers along its boundaries. Seven gauges are proposed.
- The behaviour of the Lohajang river is still largely unknown. In total 5 gauges at more or less equal distances along its course are proposed.
- With respect to the internal infrastructure, it is proposed to measure water levels at sub-compartment or cluster boundaries only. Appendix 2 proposes 15 internal gauges.

The proposed gauges are intended to provide basic information about the drainage situation in the clusters and to provide check points for hydraulic modelling purposes. With respect to the latter, professional model may want to make amendments.

It should be noted that all readings of internal gauges, are water level readings only. Measuring water level differences is only of interest if gate openings are registered and discharges are calculated. This again may serve to calculate water balances. It is proposed to leave such calculations for the time being. The emphasis should be on water level control and on the general drainage situation in the Compartment.

In addition to gauge readings, apparently flow velocity readings were done, in the past. It is proposed to terminate those as well, unless there is apparent need to do them in incidental cases.

8.2. Keeping records

All water level gauge readings of take since 1992 the Project were stored in one spreadsheet file.There were no systematic set of hard copies. The data are rather inaccessible and as a result their analysis has been insufficient.

It is proposed to store gauge readings on a monthly basis and to make monthly sheets both in spreadsheet and in hard copy. On each monthly sheet, averages are to be calculated, maximum and minimum values and the days of records. Data are processed, checked for errors and inconsistencies within a month. A database should be further developed for easy access, and analysis.

The Project should have ready access to daily rainfall data within one day. This is essential to react adequately to extreme conditions. Computer copies and hard copies should be maintained.

9. HYDRAULIC MODELLING

It is proposed that hydraulic modelling is further continued. The modelling serves two purposes:

1. To better know the behaviour of the Lohajang under different rainfall conditions and different operation scenarios at the Main Regulator
2. To better know the behaviour of the internal drainage system under different rainfall conditions.

Models are not suitable for operational purposes like CPP's setting. They take too much time, while proper operation often requires decisions within one or two days. However models are useful for design and evaluation.

At present there is confusion about the operation of the Main Regulator. Drafting a manual for the Main regulator is a high priority. Modelling will help under the following conditions:

- The whole compartment should be modelled and not individual clusters.
- Modelling should take into account average and extreme rainfall conditions.
- Modelling should be flexible and models should be easy to run, possibly in house.

The drainage network as shown in the figures 5.2A-D, together with the Main Regulator and the Lohajang may be taken as the basic model. The modelling should represent the basic water management scenarios as described hereunder.

New principles for drainage system management

The internal system

In the absence of the manuals as mentioned earlier, it is important to briefly describe principles of operation of the internal drainage system in the new situation.

The internal system is managed by the SCWMCs, CPP monitors and evaluates. In addition it gives guidance.

The aim of the operation should be to solve drainage problems within the sub-compartment itself. So sub-compartment 9 drains via Dithpur as much as possible. In the same way sub-compartment 6, 7 and 8 drain via the District Regulator.

Drainage across sub-compartment boundaries should only be done under extreme situations. Those extreme situations need to be defined in terms of water levels.

In cases as Nagar Jalfai and Aloa Raypara, procedures and criteria need to be developed by which downstream may ask temporary suspension of drainage from upstream. Suspension should not last longer than 1-2 days.

Drainage across Compartment boundaries in the south should be avoided.

Gate operators need freedom to take their own decisions. These have often to be taken within a matter of hours and consultation with their committee is impossible.

Gate operators need protection with respect to their decisions. Each committee should appoint 2-4 members, a kind of executive committee, living in the sub-compartment, who can be easily consulted by the operator at short notice.

Members of the executive committee have the obligation, when consulted, to receive the gate operator and to take quick decisions. They share responsibility for those decisions.

Crucial decisions taken by the gate operator and the members of the executive committee can be put up for discussion in the next SCWMC meeting. Decisions should be considered to have been taken with good intentions, in other words they can never be subject to fines, liabilities, court cases, etc. In case of doubt of good intentions the functionary can be relieved of his job.

The work of gate operators need to be facilitated. Travelling to the gates and consultation often takes place under conditions of bad weather and bad roads.

Gate operators may be charged with minor maintenance tasks on their gates as described before.

Gate operators should be given clear instruction about water levels at which they are supposed to open their gates. Those instructions are excerpts of the cluster manual. Gate operators are to be trained by the Project in those manuals.

The primary system

The primary system, mainly the Main Regulator, is under control of BWDB. BWDB appoints a gate operator. The relations between the SCWMCs and the gate operator go via BWDB.

CPP in consultation with BWDB should draft a manual for operation of the Main Regulator as quickly as possible. The manual should be provisional. It should be tested by modelling and by experience.

Operation of the Main Regulator should be based on water levels in the Lohajang downstream of the regulator and water levels upstream. A target could be to maintain a water level of 10.50 +m PWD downstream and establish, under these conditions an upstream level which is acceptable. If upstream levels rise by more than 0.2 m, water levels downstream are increased by the same amount.

There is a practical difficulty operating the Main Regulator with the sand bar located downstream of the regulator. As long as that is the case, water levels need to be measured at Dithpur, which requires transport. As long as experience is lacking, travelling between Dithpur and the Main Regulator may be quite often. The gate operator should have money for the drive. In addition he needs training by the Project in the operation rules.

Gates settings at the Main Regulator should not be changed too often, once a week at most, unless high waters are approaching. The BWDB should have access to high water warnings to anticipate on the situation.

The principles of operating the Main Regulator, should be discussed and (after possible amendments) approved by the Compartment Committee (Project Council). Local Government authorities concerned should be informed about the approved rules, in order to neutralise the effects of interferences by others than BWDB.

10. INSTITUTIONAL ISSUES

10.1. Issues forgone

The Project has constructed structures in internal embankments together with BWDB. Once the structure has been completed, it assigns operational tasks to the SCWMC. However, by doing that, the Project has confused the issue of who is the owner of the structure. It is not even so that by constructing the structure, BWDB becomes the owner.

In Bangladesh the ownership of secondary and tertiary infrastructure is confused. The Project has already experienced examples of that and it is not the first one. There are differences of opinion between the Project and the Local Government Engineering Department (LGED) about the ownership of infrastructure and there are no criteria to resolve those.

Assigning operational tasks to the SCWMC confuses the matter further. The Project does not have the authority to do that, only Ministries have. And within the institutional framework of Bangladesh, BWDB and LGED are the parties, which may own structures and which have O&M responsibilities. The local population is not a party, neither are SCWMCs, even if they are recognised by BWDB.

This serves to illustrate the weakness of statements about responsibilities for O&M in Bangladesh. The issue of O&M is far more complex than just charging the local population with O&M responsibilities or blaming BWDB for non-maintenance. This should be kept in mind and it would be useful if BWDB, LGED and donors take steps to clarify the issue, because it has been pending for too long already.

10.2. SCWMCs and Local Government

In the SCWMCs formed along the institutional framework for CPP First Phase 4 members of the Union Parishad (UP) are represented and the President of the committee is the union chairman. If the matter of sustainability arises, one may ponder the question whether embedding the water management organisation more in local government would not enhance their sustainability.

There are alternatives to be assessed. The level Thana has planning committees and technical committees. Meetings of these committees are open to other Government Organisations; however, few actually bother to participate. A possibility would be to make the Compartment Committee (CC) a thana committee, which makes local water management a local issue.

Few projects in Bangladesh actually integrate with Local Government. This does not enhance their sustainability. The Systems Rehabilitation Project (SRP) has taken another approach. The Directorate of Land and Water of BWDB was entrusted with water management tasks in SRP Projects. So here BWDB was charged with O&M responsibility for lower order infrastructure. However, so far this has not become a policy.

The sustainability of a water management organisation depends on the strength of the institutional framework in which it fits. As a consequence the record of projects delivering sustainable water management organisations is not promising. The solution to the problem is not at project level but at higher levels in government. It should be an issue to be addressed by the National Water Management Master Plan, which is under way. But the Plan can only propose policies not make them and the issue will certainly remain pending during the full duration of the coming phase of CPP.

10.3. Operation and Maintenance

10.3.1. Operation of internal infrastructure

The SCWMCs have been given the responsibility to operate the drainage system. As already mentioned in this report, targets of operation were put beyond the limits of what the infrastructure could deliver. During the CPP's Final Phase targets have to come down to a realistic level.

The SCWMCs need clear guidelines and manuals. CPP should provide these on the basis of the knowledge collected in the previous phase. On the other hand, CPP should realise that its targets and those of the land users should be on the same wave length. That is a condition to understand each other and to achieve a higher level of performance.

One way to achieve that is to appoint JWMOs at cluster level. They act as facilitators between the chawks and the committees. They approach the four interest groups, farmers, fishermen, landless and women, assisted by CPP's specialists (identified untill now, but expandable to other interest groups if found necessary).

The JWMOs are members of the Consultant's team. They are not employed by BWDB. They report to the Deputy Team Leader of the team, who in turn discusses their information with the SCWMCs.

If JWMOs prove successful they may be taken over by BWDB eventually.

For operation the SCWMCs make use of gate operators. To support the gate operators in the short term decisions they need to make, the committee appoints an executive committee of 2-4 members living in the sub-compartment. These members are available to be consulted on a daily basis. They are expected to take decisions (not to refer matters to the committee), and are responsible towards the committee for their decisions. The committee can discharge them, but nobody can start legal procedures against them, because of their decisions.

CPP prepares concise and practical manuals for the operation of the infrastructure. All manuals should remain open for adaptations during the course of the Project.

Operators are paid from project funds. Whether they will be paid by the SCWMCs after the Project or by BWDB has not been decided yet.

10.3.2. Operation of primary infrastructure

The operation of primary infrastructure is done by BWDB, assisted by the Consultant team. It should be defined more clearly, which parts of the infrastructure fall under BWDB and which under the SCWMCs. Consultations with LGED are desirable.

A manual for the operation of the Main Regulator is urgently needed and CPP should draft one shortly. The outer embankments of the Compartment are under ownership of BWDB, the same holds for the bed of the Lohajang river and the embankments along the river. However, regulations should be made for the SCWMCs operating gates in those embankments.

At present BWDB employs an operator for the Main Regulator. The operator is responsible to BWDB and not to the SCWMCs on Project Council. Any request to have the gate settings of the Main Regulator changed should go via BWDB.

10.3.3. Maintenance

There is no maintenance without a budget. The creation of WUGs or SCWMCs has as ultimate aim that the beneficiaries pay for the services, at least for part of the services.

It is a misconception, however, that in countries where cost recovery of Flood Control, Drainage and Irrigation (FCDI) systems has been fully realised, farmers pay for all the cost. It is a misconception in two ways:

1. Managers of FCDI systems receive subsidies from central and/or local governments; and
2. Rural housing or industrial areas profit from the drainage of the agricultural lands surrounding it and contribute to the maintenance cost.

Sharing of maintenance cost between farmers, (local) governments, and non-farmers is more the rule than the exception and pretending that the agricultural sector should bear all the maintenance cost of its FCDI systems is besides reality.

Maintenance is a set of agreements between parties about who does what and who pays what. Such agreements have to be made in consultations between such parties. Tangail town is as much part of it as the rural population of the Compartment and the matter points again in the direction of Local Government.

However, after CPP finishes, BWDB will not have a budget for the upkeep of the internal infrastructure of the Compartment, Local Government will not have a budget and CPP will not be able to set up a fund raising mechanism to cover only a fraction of the maintenance cost.

Instead of putting so much emphasis on the sustainability of O&M systems, it would help the local population more to designs schemes by which it can benefit at least during the life time of the Project.

Such a scheme is the Minor Work approach for which Guidelines for Execution have been drafted and approved by BWDB. Minor Works, together with an approach towards cooperation and conflict resolution in water management should receive the main attention. The comment to be made with respect to the Minor Works Guidelines is that it is not obvious that the such works should be executed under BWDB supervision. At least consultations with LGED (and conflict resolution) are advisable.

11. ENGINEERING (INCLUDING "MINOR WORKS")

11.1. Introduction

The "engineering" issues, assessed, planned and already partially implemented by the project, are a product of involvement of local people in their own area, regarding watermanagement issues.

As the overall project objectives states:

"To determine whether the concept of compartmentalization is a good investment in contemporary Bangladesh, i.e. whether it will provide a more secure environment for intensive agriculture, and integrated/ urban development and thereby improve the economic security and quality of life".

It is generally acknowledged that the participation approach which the project used, opened up new avenues and the obtained experiences in the field helped engineering the discussion on how, how far etc. peoples participation should go, where the responsibilities should be etc.

For involvement of the people during planning, the project recognized three defined phases i..e :

1. Needs Assessment
2. Consultation Meetings
3. Institutionalization

The Needs Assessment and Consultation Meetings have been finalized. The institutionalization process has already started, but in some areas adjustments are required to be made (see Volume 1: Main Report Chapter 3.4). As a results of this, implementation (physical) works have been constructed already, mainly confined to four out of six clusters. The works under Cluster IV (south-western corner of the project area), Cluster V (Tangail Town) and Cluster VI (Adjacent Areas) are under implementation (Figure 11.1).

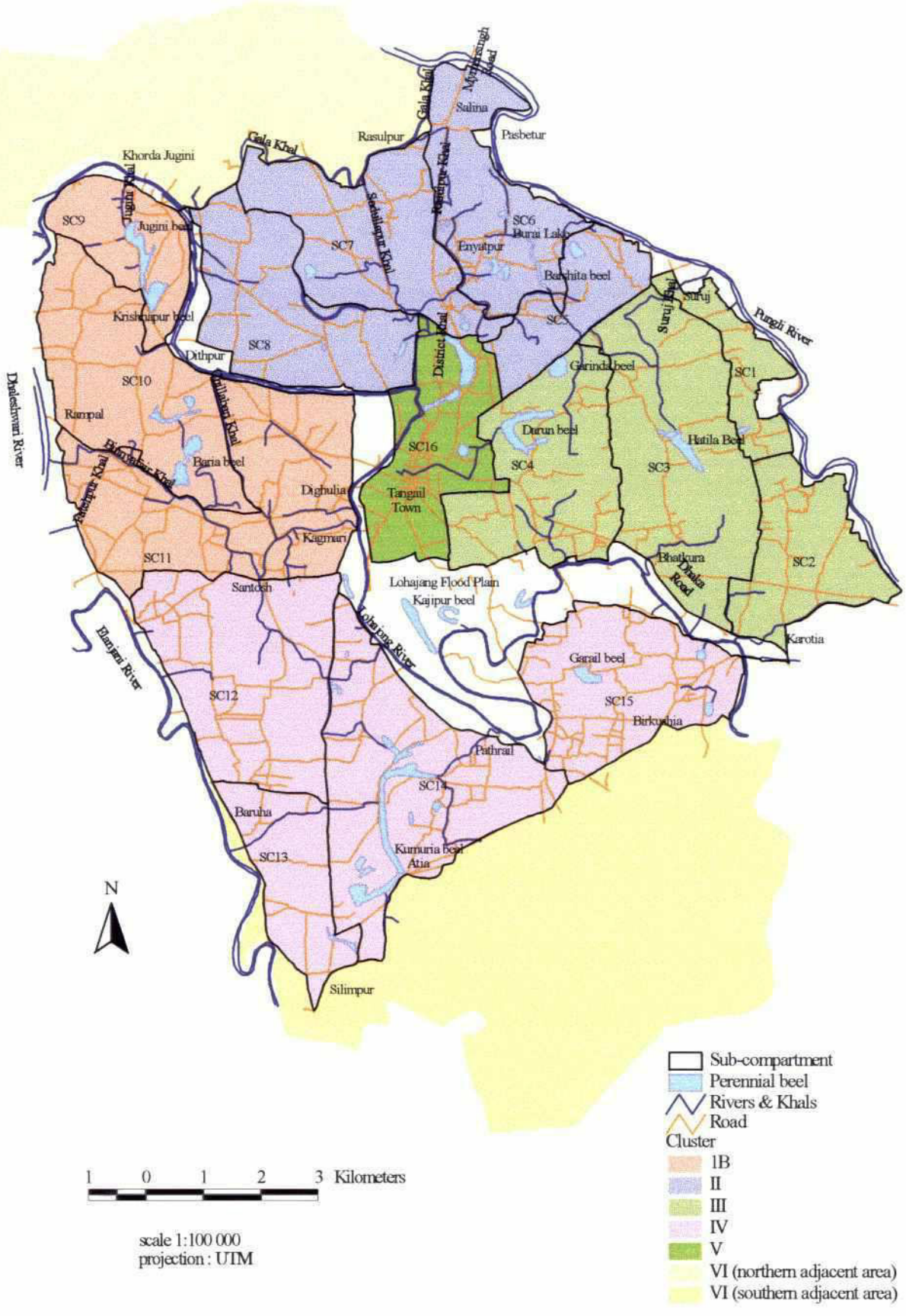
The perception of the people living in the project area, had in fact never been properly and independently assessed. From various corners, the impression was created that this perception of the people regarding the project's activities and its actual impact, were less than adequate, or not acknowledged in a positive sense. At the same time, the impression surfaced that procedures related to land acquisition were not be followed correctly or adequately.

In order to investigate these two main points, an independant mission was commissioned by the donors, the Netherlands and Germany. The main conclusions of the report are that the knowledge of people regarding the project is very high (92.5%), in particular having in mind the Bangladesh rural context. Furthermore, the appreciation of the project by the population with a large majority (over 80% rating it a good (38%) or farm project (42.8%) is considered a very encouraging conclusion.

At the same time improvements were suggested in the field of the formulation of a comprehensive O&M plan aiming it a sustainable watermanagement system in the compartment; furthermore a critical assessment of existing, on-going and planned interventions, especially regarding its financing and O&M.

The following interventions are planned, on-going or already completed; however, adjustements and alternations may be performed based on close monitoring of the actual function and operation of the intervention.

Fig 11.1 Clusters & Sub-compartments, CPP



Compartmentalization Pilot Project Tangail

September 96 c:\win32app\cpp\data\Tantot.apr

On particular note of caution should be further elaborated upon. The long term viability, sustainability and replicability of the compartmentalization concept will very much depend on the financial management of this project.

The recently concluded joint donor-review mission (Feb. 1997) concluded that a very cautious approach should be adopted regarding the implementation of more-than-absolutely-essential works. A first attempt to accommodate this approach has been included by the project by formulating "Guidelines for Minor Works", which have been approved already by the BWDB.

The physical implementation activities are divided into:

1. New work (ongoing of 1996-1997);
2. Carried-over works (from previous financial year(s); and
3. Planned work for 1997-1998

Also the land acquisition status has been mentioned structure wise. The Quality Control Cell under CPP collaborates well with the Executive Engineer BWDB and has staff, in order to ensure proper quality. All disbursement requests are individually checked monitored and rechecked if necessary by the quality control engineer and his staff.

11.2. Minor works activities

For water management testing, different types of water control structures came into operation in the last two monsoon of 1995 and 1996. Based on the experience of water management testing, it was observed that a number of chawks in different sub-compartments had considerable water management problems to solve. To mitigate the above problems, "minor works" activities are taken into account. The following activities are considered under " minor works":

- Excavation and reexcavation of small canals, link canals and drains;
- Purchase of ring pipe and installation;
- Construction of wooden foot bridge and culverts;
- Construction and installation of structures, gates, fallboard etc. at the site of flooding and drainage for water management of chawks; and
- Other small works as approved by the Project Director.

It should be noted here that no land acquisition programme would be taken for the above activities and the SCWMC has to ensure the required land for the minor works.

For carrying out the minor works, the SCWMC's were asked to submit the schemes that contains name, purpose and detail descriptions of the schemes. The SCWMC is to show the location of the proposed works in a mouza map including the plot numbers. The SCWMC has also to ensure that LCS under each sub-compartment would be engaged for the minor works.

A three member committee has been formed to verify the feasibility of the proposed schemes from technical point of view and consists of the following members:

1. One SDE from BWDB-Project Team;
2. One WME from Consultants Team; and
3. One selected member from SCWMC.

Table 11.1: Land acquisition status, works FY 96–97

Sl. No.	Name of Work	Code No.	L.A Case No.	Area in hectare	DLAC		Awaiting Ministrie's Clearance	Notice Under Section 5	Notice Under Section 6	Estimate receiced	Fund received	Possession received
					Awaiting	Approved						
1.	Deojan Regulator	40102	25/95–96	0.247					0.247			
2.	Burburia WCS	40303	19/95–96	0.069			0.069					
3–10.	Drain of Tangail Town	51501	Not required									
11.	Char Kagmara WCS	20312	31–8–95	0.185	0.185							
12.	Bara Atia WCS	40304	31–8–95	0.069	0.069							
13.	Berabuchna WCS	40302	–	0.287	0.287							
14.	Birpushia WCS	40314	33/95–96	0.271		0.271						
15.	Pachkahonia PC	10405	30–8–95	0.040	0.040							
16.	Kumulli GPC	40406	34/95–96	0.163					0.163			
17.	Khagjana GPC	40407	35/95–96	0.109					0.109			
18.	Aloabhabani GPC–1	40402	30–8–95	0.028	0.028							
19.	Aloabhabani GPC–2	40403	42/95–96	0.032			0.032					
20 & 21.	Aloa Khal	40502	26–9–95	2.980	2.980							
22.	Berabuchna–Kumeri Khal	40503	26–9–95	1.765	1.765							
23 & 24.	Baruha Khal	40508	68/94–95	0.089								0.089
25.	Deojan Khal	40511	26/95–96	2.356					2.356			
26.	Indrobelta Khal	40505	19–9–95	0.206	0.206							
27.	Kumulli Khal	40514	26–9–95	0.821	0.821							
28.	Baghil Ainapur Soyabeel Khal	60506										
29 & 31.	Mohishanandal to Deldar Char Road	61211										
32.	Beel Muril Foot Bridge	61203										
33.	Chardurgapur Foot Bridge	61202										
34.	Bara Bashalia Dakhin Para Primary School to Bara Bashalia Rasulpur Road	61204										
35.	Road from Choto Bashalia to Gala Purbapara	61206										
36–38.	Road from Senergagorjan Bridge to Faliarghona Madra	61207							Land acquisition not required			
39.	Road from Galachar Primary School to Muhammad Ali's House	61208										
40–41.	Road from Beel Muril to Chowdhury Malancha	61209										
42–44.	Road from Beel Muril to Deldar Char	61210										
45.	Fatehpur Culvert	10412										
46.	Fatehpur Irrigation Inlet	– –										
47.	Re–excavation of Gala khal under FFW	61102										
48.	Re–excavation of Lohajang river under FFW	61101										
	TOTAL:			9.717	6.381	0.271	0.101	–	2.875	–	–	0.089

Filea:land–1.wkl

Table 11.2: Land acquisition status, carried over work, carried over work (ongoing)

Sl. No.	Name of Work	Code No.	L.A Case No.	Area in hectare	DLAC		Awaiting Ministrie's Clearance	Notice Under Section 5	Notice Under Section 6	Estimate receiced	Fund received	Possession received
					Awaiting	Approved						
1	Rampal Khal	10506	10/93–94	1.350								1.350
2	Khurda Jugini Khal	10501	58/95–96	1.230			1.230					
3	Gala to Rasulpur Embkt.	00610	1/94–95	2.840								2.840
4	Dharerbari Khal	20506	18/94–95	0.994								0.994
5	Garinda Jalfai Khal	30507	26/94–95	7.897								7.897
6	Khudirampur Khal	30502	20/94–95	0.986								0.986
7	Bamni Khal	20509	27/94–95	10.679				10.679				
8	SC Embkt. Dharerbari District	20603	33/94–95	10.903		10.903						
9	Rasulpur Khal	20508	42/94–95	7.372				7.372				
10	Kandila Bridge	20404	59/95–96	0.272		0.272						
11	Sarutia – Chillabari SC Embkt.	10605	43/94–95	0.283					0.283			
			40/95–96	1.769			1.769					
12	Pardighulia SC Embkt.	10605	56/94–95	0.097								0.097
13	Salina – Dhapnazar Embkt.	00613	19/94–95	3.482								3.482
14	Rasulpur – Salina Embkt.	00611	40/94–95	3.186								3.186
15	Bararia – Suruj Embkt.	00613	6/94–95	1.979								1.979
16	Dhopachara Beel – Sadullapur Khal	20505	45/94–95	0.432								0.432
17	Sadullapur Inlet	00402	39/95–96	0.235					0.235			
18	Khudirampur WCS	30302	62/94–95	0.162								0.162
19	Sarutia BC	30411	61/94–95	0.138					0.138			
20	Bararia GPC	20318	47/95–96	0.146			0.146					
21	Boundary pillars (fixing only)	––	LAND ACQUISITION NOT REQUIREI									
	TOTAL:			56.432	–	11.175	3.145	18.051	0.656	–	–	23.405

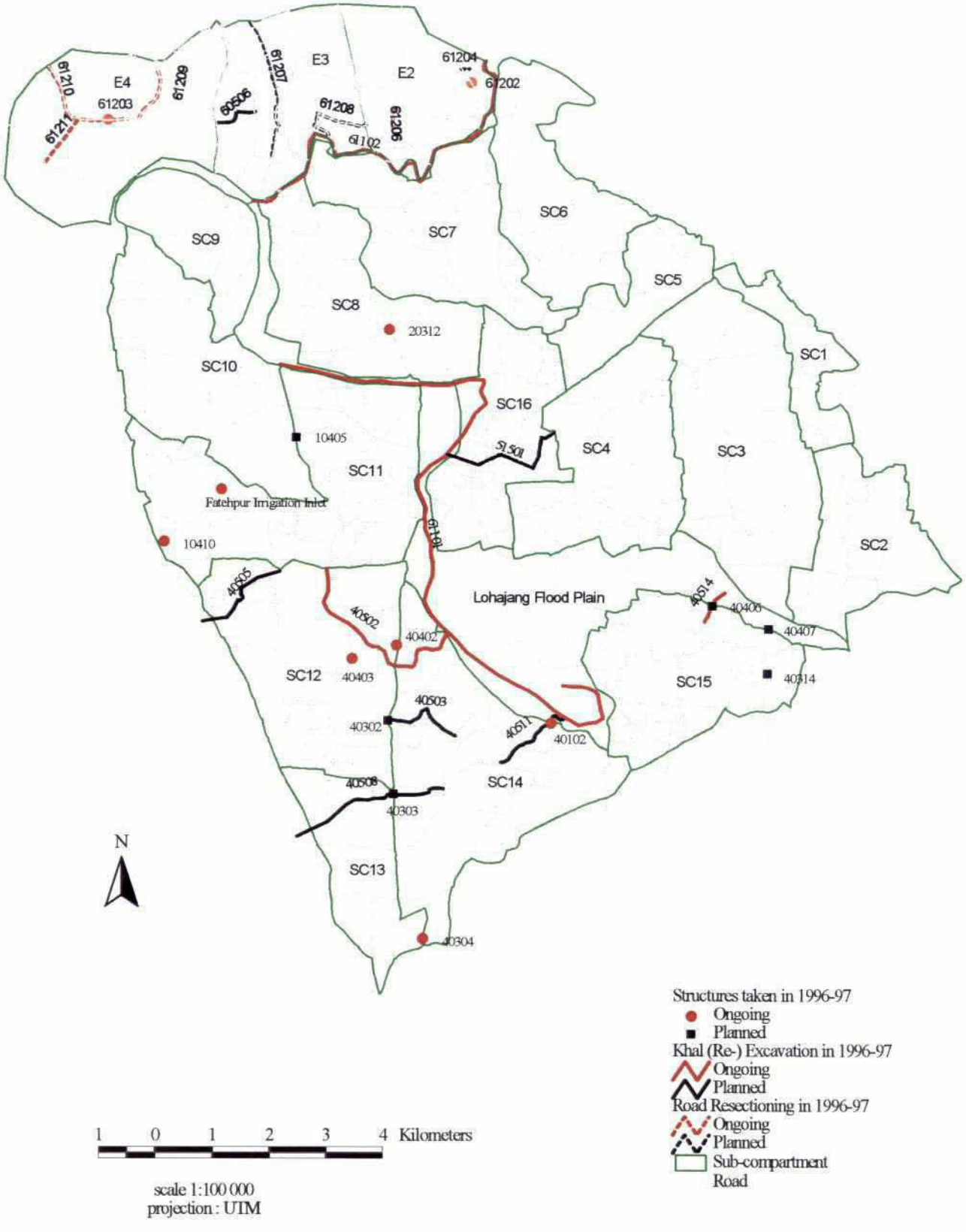
b:land–2.wk1

Table 11.3: Land acquisition status, works planned for FY 97–98

Sl. No.	Name of Work	Code No.	L.A Case No.	Area in hectare	DLAC		Awaiting Ministrie's Clearance	Notice Under Section 5	Notice Under Section 6	Estimate receiced	Fund received	Possession received
					Awaiting	Approved						
1	Gharinda Regulator	30104		0.145	0.145							
2	Sadullapur Culvert (gate fitting only)	20201	Land Acquisiton not Required.									
3	Aloa Bhabani WCS	40301	43/95–96	0.154				0.154				
4	Bandabari GPC	40311	36/95–96	0.085			0.085					
5	Singerkona – Dhannya Chowdhury khal	10502	2/96–97	1.350		1.350						
6	Tangail Drain :											
	a) Earthen	51502		3.500	3.500							
	b) Internal	51503	Land Acquisiton not Required.									
7	Mamudpur GPC	40408	18/95–96	0.036				0.036				
8	Kandor GPC	40409	22/95–96	0.251				0.251				
9	Kumuria GPC	40410	31/95–96	0.081							0.081	
10	Khanpur Borrow Pit	10510	10/96–97	1.142		1.142						
11	Santosh Khal	40501	28/95–96	0.619		0.619						
12	Bara Belta Khal	40504	27/95–96	3.028		3.028						
13	Katakhali LC	40506	41/95–96	0.425							0.425	
14	Bagerchara LC	40507	21/Sept.95	0.610	0.610							
15	Mamudpur LC	40509		0.846	0.846							
16	Pathrail khal	40513	20/95–96	1.409		1.409						
17	Kumargery khal	40517	26/Sept.95	0.478	0.478							
18	Baruha LC	40510		2.830	2.830							
19	Singerkona beel – Binnafair khal LC	10504	44/93–94	4.080				4.080				
20	Chinakhola Foot bridge	40404	Land not need.									
21	Pathrail GPC	40405	Included in the proposal of Pathrail khal.									
22	Dosagia khal	40512	23/95–96	1.696	Dropped							
23	Dighulia–2 CDO	10307	Included in the proposal of Khanpur Boropit									
24	Bara Basalia Regulator	60101	Land Acquisition not Required.									
25	Refuge sites under FFW (18 nos.)	61104 to 61121	Land Acquisition not Required.									
26	Lohajong loop cut under FFW	61103	Land Acquisition not Required.									
	TOTAL :			21.069	8.409	7.548	0.085	4.521			0.506	

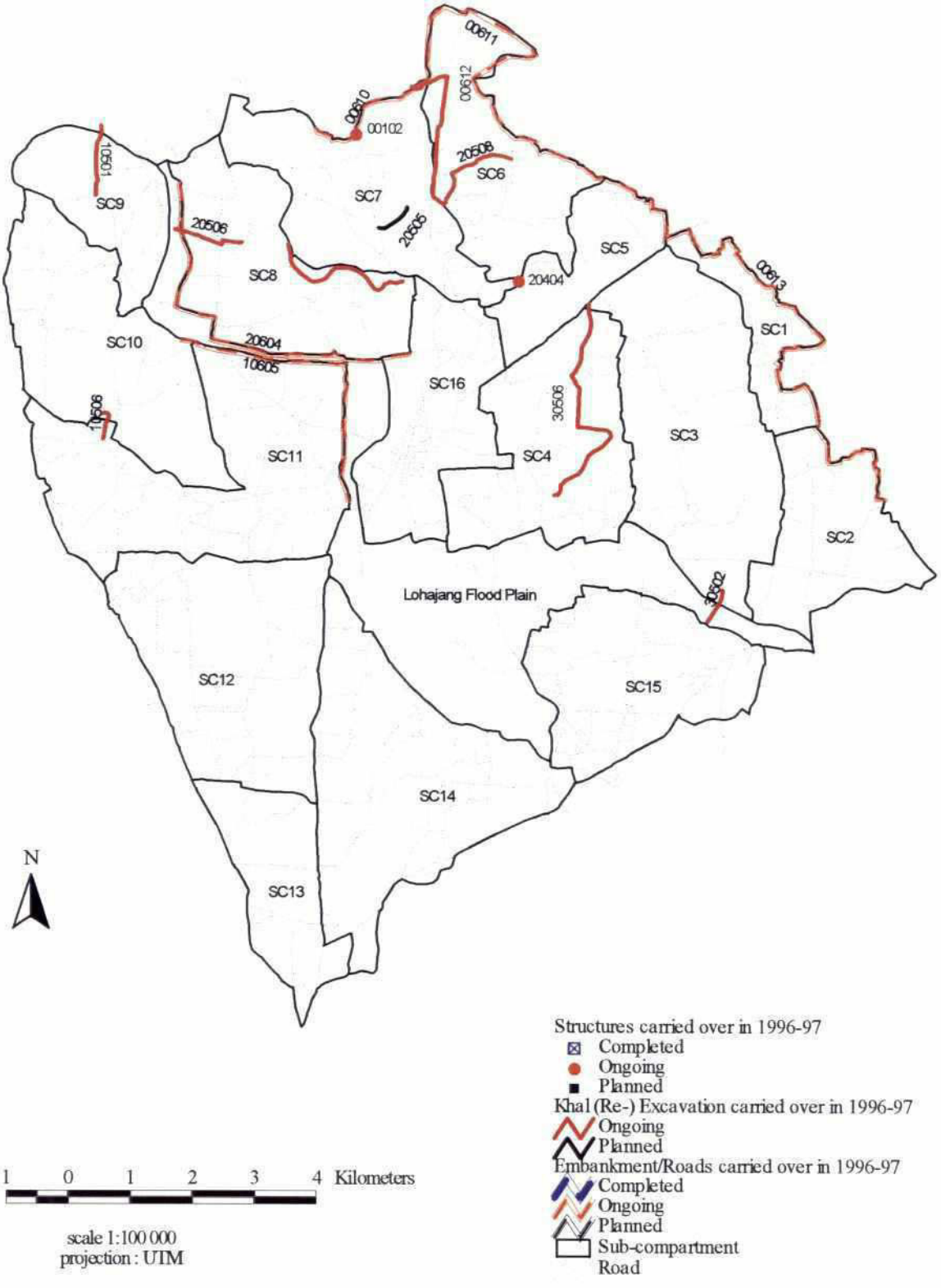
a:land–3.wk1

Fig 11.2 New Works for FY 1996-97



Compartmentalization Pilot Project Tangail

Fig 11.3 Carried Over Work from FY 1996-97



After field investigations, the above committee prepare a feasibility report with recommendations and submit it to the Project Director through XEN for final approval. After having the final approval, the XEN would take necessary arrangement according to the BWDB rules to implement the schemes. The cost of each scheme should not exceed taka 1.5 lakh.

The SCWMC would be treated as Class "D" contractor and would receive the work order as the schedule rates of BWDB circle. The SCWMC has to pay the schedule rates for purchasing the tender documents but the registration fee and earnest money would be waived. But the vat and taxes arising from the contracts would be deducted from the total bill of the schemes. The SCWMC has to recruit the labour from the work sites and violation of this may be the reason of cancelling the contract agreement. For recruiting the local labour, the SCWMC has to give the priority of the members of BRDB or NGO groups. If the SCWMC fails to complete the work in time, penalty would be made according to the contract agreement. CPP division will supervise the works and quality control engineer/drainage engineer will visit the work site with a certain time interval.

The Tangail compartment consists of 16 sub-compartments of which the first fifteen sub-compartments are directly related to water management. Sub-compartment 16 is the Tangail town where no specific water management activities have been under taken. Field investigations and related recommendations have already been made for a total of 9 sub-compartments and the field investigations of the remaining sub-compartments are in progress and expected to be completed within month of May 1997.

11.3. Overview of work (implemented in FY 96-97), carried-over work and planned work (for FY 97-98)

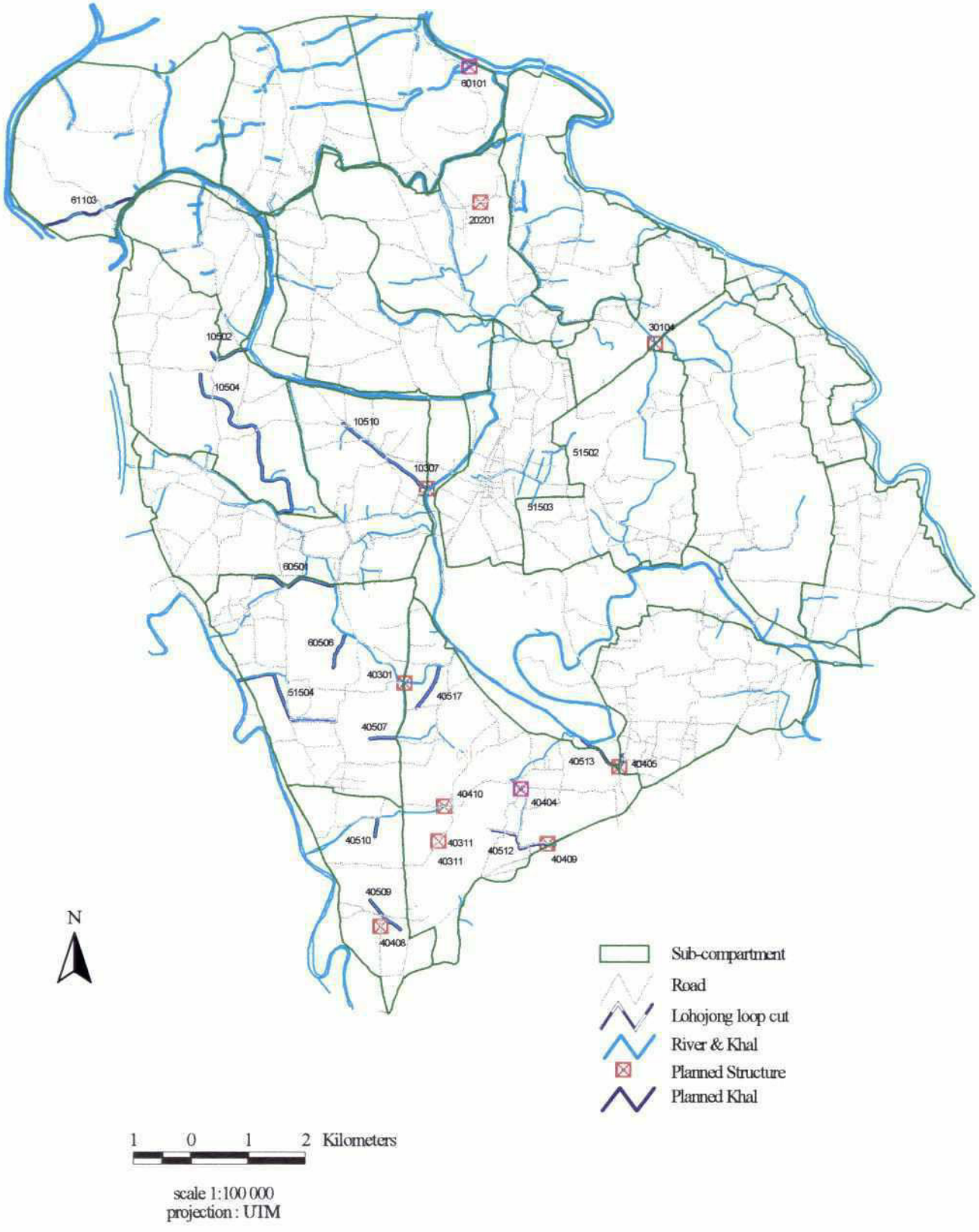
Table 11.1-11.3 and Figures 11.2-11.4 provide an overview of the progress on already implemented, on-going and planned interventions regarding land acquisition and its progress on the various stages involved in this.

Regarding the planned interventions, adjustments are expected to be made during the monsoon of 1997.

Table 11.4: Progress land acquisition current works and works planned; status 2nd quarter 1997

Type of Works	Land required (ha)	Compensation paid and possession received (ha)	Outstanding for payment (ha)
A. Works FY 96-97	9.717	0.089	9.628
B. Carried over works (ongoing)	56.432	23.405	33.027
C. Works planned for FY 97-98	21.069	Nil	21.069
TOTAL :	**87.218**	**23.494**	**63.724**

Fig 11.4 Planned works for FY 1997-98



April, 97 c:\reza\planned98 SR

Compartmentalization Pilot Project Tangail

PLANNED WORKS FOR 1997-98

Sl. No.	Name of Works	Code No.
1	Gharinda regulator	30104
2	Sadullahpur culvert (gate fitting only)	20201
3	Aloa Bhabani WCS	40301
4	Bandabari GPC	40311
5	Singarkona-Dhannya Chowdhury khal	10502
6	Tangail Drain:	
	(a) Earthen	51502
	(b) Internal	51503
7	Mahmudpur GPC	40408
8	Kandor GPC	40409
9	Kumuria GPC	40410
10	Khanpur borrowpit	10510
11	Santosh khal	40501
12	Barobelta khal	40504
13	Katakhali LC	40506
14	Bagerchara LC	40507
15	Mahmudpur LC	40509
16	Pathrail khal	40513
17	Kumergary khal	40517
18	Baruha LC	40510
19	Singarkona beel-Binnafair khal link canal	10504
20	Chinakhola Foot Bridge	40404
21	Pathrail GPC	40405
22	Dosagia khal	40512
23	Dighulia-2, CDO	10307
24	Barabashalia regulator	60101
25	Refuge sites under FFW (18 nos.)	61104 to 61121
26	Lohajang loop cut under FFW	61103

12. DHALESWARI-SPILL-CHANNEL, JAMUNA ACCESS ROAD AND RAILWAY

12.1. Dhaleswari closure and opening of a new spill channel and subsequent development

1) Background of Dhaleswari closure:

- Dhaleswari northern intake, the main source of water of CPP was closed by JMBA during October 1994.
- An Inter-Ministerial Committee was formed by the Government in March 1995 to investigate the possible alternatives to restore the flow in Dhaleswari river.
- The above mentioned committee submitted its findings during June 1995, and recommended to construct a new Link Channel 3km downstream of Jamuna bridge site. The location and size of the new link channel was determined by model study and field verification/survey.

2) Development of Spill Channels:

- During monsoon of 1995, new spill channels developed just south side of the bridge site and restored the flow of water in Dhaleswari and its distributaries to the same extent as it was before the closing of Dhaleswari northern intake (shown in the enclosed index map).
- JMBA, through a communication vide their no. JB-10/90-675 dated 17.7.95 with MWR, recognised the existence of this newly developed spill channel and assured the project of continued water flow through this newly developed spill channels.
- During the months of July and August 1995, required quantity of water for the testing of CPP (FAP 20) was available in the Dhaleswari and Lohajang river.

3) Subsequent Development:

- In a meeting of Dhaleswari Committee (Inter-Ministerial Committee Meeting) on 13.9.95 under the chairmanship of Additional Secretary, MWR, detail discussions were made on the above mentioned newly developed spill channels and there after it was decided that a study should be conducted on the newly developed spill channel within the scope of ToR of JMBA.
- JMBA, through a communication vide their no. JM-10/90-129 dated 28.2.96, with MWR, intimated that study has been completed as per decision of Dhaleswari Committee Meeting. However, CPP managed to obtain some study reports unofficially. Summary of all relevant study reports, as collected by the project has been submitted to Ministry of Water Resources through WARPO in mid April, 1996.
- In one of the study report, namely, "Study of the new Dhaleswari Intake, by JMBA (RPT, NEDCO, BCL), March 1996", it is mentioned that development of the new intake channel to full size can best be obtained by re-aligning the entrance of the intake and by lowering the sill at the entrance.
- According to the study report, as mentioned above, JMBA completed the excavation for re-alignment of the entrance of the intake channel (along the previous alignment of 1st spill channel) and closed the entrance of the new spill channel developed during July 1995 by mid May 1996 (shown in the enclosed index map).
- JMBA did not make any arrangement for stabilization of this new entrance at that time.
- During last week of May 1996 local people has built a earther closure on the newly developed channel at about 1.50km downstream from the entrance of spill channel because during flood of 1995 they lost of several houses agriculture land due to development of this new spill channel and also on the apprehension that during 1996 flood season they will lost more houses and land due to re-alignment of entrance of spill channel by JMBA. The spot was visited by Mr. R.M. Schutte, Charge Affairs of RNE and Mr. Bert Diphoorn, First Secretary (Dev.) RNE, and project personnels on May 29, 1996. Subsequently the closure was partly recovered with the assistance of local administration and the remaining portion was washed away during high flood of 1996.
- No problem was arrised for flow of water to CPP area during flood season of 1996.
- JMBA through a communication to MoWR vide letter no.JB/405 dated 1.7.96 agreed to take up protective work for the both bank of spill channel for safeguard of public property and JMBA property and requested the MoWR to prepare scheme for protective work and the work will be implemented by BWDB as a deposit work of JMBA. Accordingly BWDB has completed the preliminary works for designing the protective work of spill channel and the design is underway of completion soon. However,

CPP is not concerned about the bank protection of spill channel, the only concerned of CPP is the stabilization of mouth the spill channel.

Two developments took place:

Based on concern expressed by CPP through the Dhaleswari Committee and other interested parties, a fine-tuning of the hydrological/mathematical modelling took place.

As explained before the hydrological modelling of bank protective measure in the spill channel itself would not be justified if the stabilization of the mouth of the spill channel would not be guaranted.

In connection with the construction of the Jamuna Multipurpose Bridge (JMB) across the Jamuna River in Bangladesh the need for model predictions of the river morphology at the bridge site has been advocated by the Panel of Experts, the Construction Supervision Consultant (CSC) in July 1995, the Management Consultant (MC) and lately by independent experts from the World Bank, Prof. J. Fredsoe (morphological aspects) and Prof. I. Payne (environmental aspects).

Danish Hydraulic Institute (DHI) in collaboration with the Surface Water Modelling Centre (SWMC) was commissioned a mathematical modelling study of the Jamuna River near the JMB. The objective of the study, which started in August 1995 and continues to November 1996, was to forecast critical conditions that may arise during the various construction stages due to changes in morphology and hydrodynamics. The project was executed by the World Bank and financed by the Danish Trust Fund.

The construction of JMB and the associated river training works (RTW) have been delayed and RTW, which potentially are sensitive to morphological changes during the construction period, will not be completed before 1997. At the same time renewed concern has been raised about the impact of the bridge. On this background the WB have requested DHI to make a proposal for a continuation of the on-going modelling project.

The key immediate objectives of the continuation of the ongoing mathematical modelling study are to forecast possible critical conditions in river hydrodynamics and morphology in the remaining construction period until the end of 1997 and to assist the JMBA and its consultants in defining and carrying out the outlined erosion policy as well as impact assessment studies. One of the objectives is:

- Forecasts of morphological developments in front of the Dhaleswari Spill channel and simulation of the effect of various measures such as dredging to keep the spill channel open.

- Prediction of the short-term (1-2 years) as well as the long-term (several years) development of the Dhaleswari river. The objective is to assess the impact of the JMB on a long-term basis both with respect to erosion, accretion and flood dynamics inside the CPP area. The findings supplement the analyses of morphological developments at the offtake area.

In a discussion meeting on January 2, 1997, whereby representatives of all parties were present, it was decided that this second phase of modelling indeed will provide the necessary information. Furthermore, it was also suggested to revive the matter of the artificial spill channel as conceptualized by CPP. This would be incorporated in the new modelling exercise.

12.2. Alignment of By-Pass road and Rail road connecting to Jamuna Bridge through CPP

The CPP has initiated and is currently implementing an innovative concept of water management system by control flooding and controlled drainage. The most important task of this project is to test the infrastructure both technically and institutionally. The project has run half of its course. During 1995 and 1996 the survey of Tangail By-Pass Road and Rail Road connecting to Jamuna bridge have been completed. The proposed both alignments cut the Tangail CPP compartment and specifically affects the sub-compartment 2, 3, 4, 5, 6 and little of 7 & 15 covering 30 chawks where most of the planned intervention and institutions are already completed.

Alignment of By-Pass Road:

A layout of the road with location of proposed bridge/culvert was procured by CPP in late 1995 where 7 nos. bridge/culvert proposed on the by-pass and 7 nos. reconstruction and 1 no. new proposed on the existing road passing through CPP.

Alignment of Rail Road:

No exact and detail alignment of Rail road could be obtained by CPP. However, the rough alignment of rail road was received from the Railway department where details of location of bridge/culvert are not mentioned or shown.

In the 9th Steering Committee Meeting of CPP held on 18th June 1996 a decision was taken to carryout a study to the impact of these two interventions in order to propose for mitigation measures to the concerning department. The project completed the study on the impact of these two interventions. However, at this stage a detailed assessment could not be made regarding the impact of the construction of these two interventions. In the study report, CPP proposed for the following mitigation measures:

By-Pass: 2 nos bridge/culvert to be provided in the by-pass in addition to the proposed bridge/culvert by the R&H department.

Rail road: According to the rought alignment of rail-road, a total of 9 nos. bridge/culvert are to be provided out of which 5 nos. over the existing channel/khals and 4 nos. to accomodate overland flow.

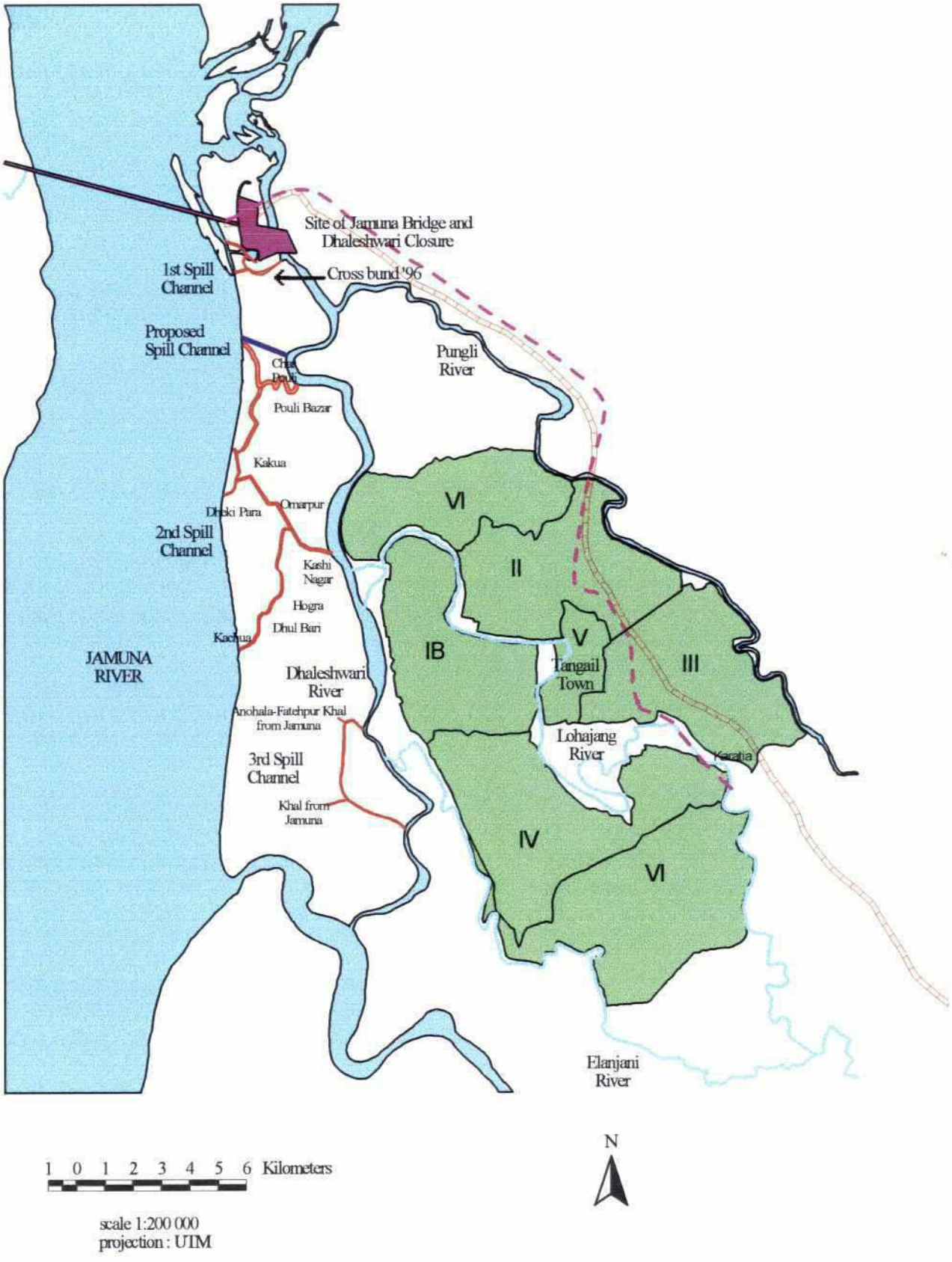
The details of these proposals have been mentioned in the study report.

The study report finds the following direct impacts to CPP.

- planned water management;
- overland flow;
- drainage congestion;
- navigation;
- loss of agriculture land due to borrowpit construction adjacent to the alignment; and
- re-define of and sub-compartment boundaries.

The study report on the impact of these two intervention is under scrutiny by the Design Directorate who deals with all the detail design of the CPP interventions. Proper coordination between the various planning and implementing agencies are urgently required. Planning regarding both By-pass road and railroad are done without any information provided to CPP.

Fig 12.1 CPP, the Dhaleshwari Closure, Jamuna Access Road, Tangail Bypass & Jamuna Railway



Compartmentalization Pilot Project Tangail

13. PLAN OF ACTIVITIES, PERSONNEL PLANNING AND BUDGET ALLOCATION

The main emphasis for watermanagement to test the concept in its practical settings and provide information of the functionality and effectiveness of the various components of the concept. A detailed list of activities has been formulated, together with the required personnel planning and budget allocation (Figure 13.1).

The Bangladesh Drainage Engineer or rather the Water Management Engineer of CPP was also Deputy Team Leader. Given the fact that a renewed emphasis on water management is required, one can see that the position of Water Management Engineer needs strengthening.

In order to facilitate and enhance communication from field level to the CPP office, a proposal has been made in which JWMOs are stationed in the field. They need much attention and the information they bring forward has to be discussed with the 15 SCWMCs. To this has to be added involvement with the 16th sub-compartment, Tangail Town.

In addition to this, other subjects require attention and frequent contacts with the SCWMCs as well. Those are:

- The on-going construction programme
- By-laws and Regulations
- The anticipated changes in water management
- Discussions on manuals and procedures with respect to the internal infrastructure
- Discussion on manuals and procedures with respect to the primary infrastructure

In addition to consultations on these matters with SCWMCs, much detailed work is still to be done, such as:

- The manuals and procedures under the new concepts of water management need continuous adaptations.
- Field work is required for checking maximum water levels, capacity of structures, direction of flow, the controlled flooding.
- Field work is required to learn to know better the behaviour of the Lohajang under influence of Main Regulator operation.
- Supervision of the reorganisation of data collection and data processing
- Assistance to the new modelling effort

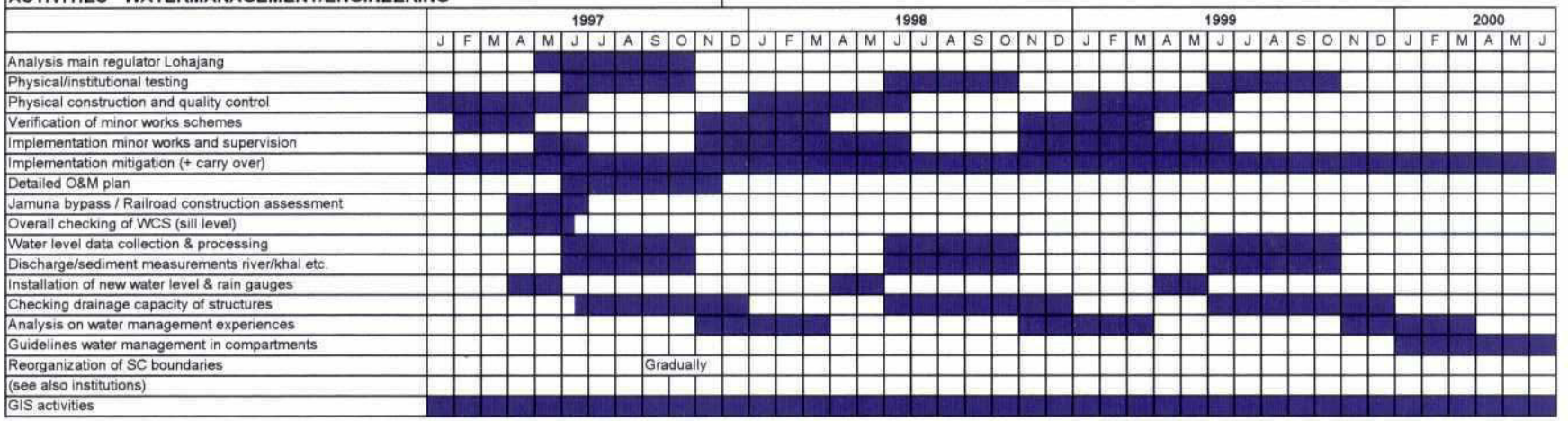
The proposal is that CPP appoints a second Bangladeshi WME, at academic level but still junior to the Deputy Team Leader for all the detailed tasks.

The CPP team will be strengthened by an expatriate Associate Expert financed from Dutch funds. His task is the continuation and further development of the Geographic Information Systems (GIS), available in the Project's offices and also to pay due attention to water management issues. It is proposed to investigate whether the job assignment of the Associate Expert can be reoriented towards water management. He will provide the theoretical background for the future water management. An analysis and compilation of the available data basis on water levels in the rivers, at structures, agricultural optimal and maximum levels and rainfall is urgently needed.

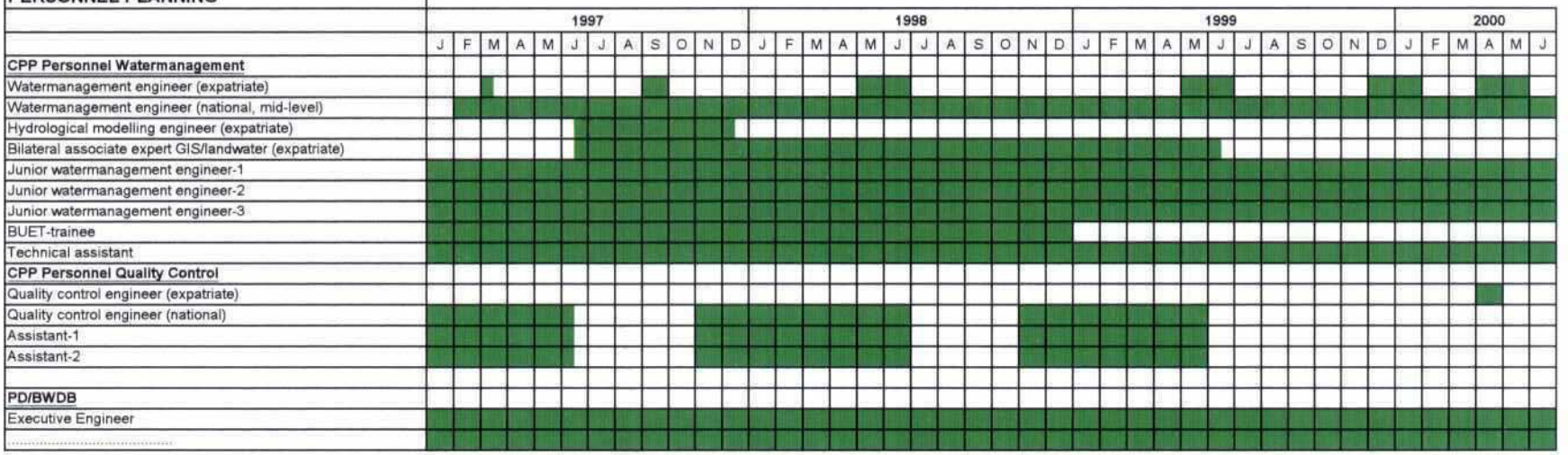
CPP at present employs a Junior Engineer, who is in charge of the collection, processing and storing of data. In addition, he carries out topographical and hydrological field measurements. His position should be maintained as well during the next phase of the Project but he needs guidance with respect to storing and processing of data.

An overview of the main activities, the personnel planning and allocated budget is depended in Figure 13.1.

FIGURE 13.1: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET:
ACTIVITIES - WATERMANAGEMENT/ENGINEERING



PERSONNEL PLANNING



BUDGET

	1997	1998	1999	2000	TOTAL
Hydrometeorological survey	14000	5000	5500	1000	25,500
Sediment survey (quantative)	1500	1500	1500	0	4,500
GIS	10000	6000	4000	2000	22,000
Quality control	9500	4000	1500	500	15,500
Database development	5000	2000	2000	2000	11,000
Hydrological model	5000	8500	3000	3000	19,500
Miscellaneous	5000	3000	2500	1500	12,000
TOTAL :	**50,000**	**30,000**	**20,000**	**10,000**	**110,000**

APPENDICES TO

ANNEX 1A

APPENDIX 1:	**REVISION OF SUB-COMPARTMENT BOUNDARIES**

APPENDIX 2: **TASKS JUNIOR WATER MANAGEMENT OFFICER (JWMO)**

APPENDIX 3: **LIST OF GAUGES TO BE MAINTAINED**

APPENDIX 1: REVISION OF SUB-COMPARTMENT BOUNDARIES

INTRODUCTION

The observations in this appendix are based on the figures A1, A2, A3, A4 and A5 and not on field observations. The terminology Drainage Systems refers to the systems shown in the figures. The text does not take into account whether systems or structures have been finished or not, whether they are functioning properly etc.

This chapter intends to develop a water management design on the basis of what has been implemented or will be implemented in the field. Where new sub-compartment boundaries can be quickly implemented, it should be done. Where implementation requires some more time, the water management design serves as basis for future decisions.

CLUSTER 1b
sub-compartment 9

Sub-compartment 9 consists of the chawks 1A - 1G. It is drained by the Jugini Khal in the north, which starts at the Khorda Jugini inlet and drains into the Jugini Beel. The Jugini inlet allows water to be taken in from the Lohajang river upstream of the Main Regulator.

The Jugini Beel is situated in chawk 1D. It changes into the Krishnapur Beel in chawk 1E. The latter beel is drained by the Dithpur Khal, which ends at the Dithpur outlet. The Dithpur outlet discharges into the Lohajang river downstream of the Main Regulator. Both beels, the Jugini Beel and the Krishnapur Beel, are perennial beels. Chawk 1B contains the Dhali Beel, which is a non-perennial beel. The Dhali Beel is connected to the Jugini Beel.

All chawks of the sub-compartment have access to a drainage system, with the exception of chawk 1C. Chawk 1C, however, drains via road culverts into chawk 1D. There are no Project structures at the boundary between the two chawks and, as far as water management is concerned, the two chawks could be merged. The Krishnapur WCS connects the chawks 1A and 1B, although both chawks have outlets into the Jugini Beel.

The Jugini Beel and the Dithpur Beel have direct access to water from outside the Compartment, while they can be drained towards the Lohajang river, downstream of the Main Regulator. However, water levels maintained in the two beels will affect drainage conditions in almost all chawks. The Dhali Beel does not have access to outside water.

The sub-compartment has a more or less independent intake and drainage system, without interference with other sub-compartments.

Sub-compartment 10

Sub-compartment 10 consists of the chawks 2A - 2C, 3A - 3F and 4A - 4B. Most of the chawks have direct access to drainage. The Singerkona Khal runs through the sub-compartment, with its origin in chawk 3B. Along the southern boundary there is the Binnafair Khal and along the eastern side the Chillabari Khal. The only chawk, which does not have direct access to these drains is 4A, located along the Dhaleswari river. The chawk has a Project intervention, Chowbari WCS, to drain into chawk 4B.

The Singerkona Khal has the Bhangabari CDO at its downstream end. The other two drains do not have such control structures. The khal runs through a series of beels which are all perennial. Manipulation of water levels in those beels directly affects drainage conditions in the chawks upstream. If the Bhangabari CDO would be closed for fisheries purposes, agriculture in all chawks along the Khal will feel the impact.

The sub-compartment does not have access to outside water. With respect to drainage outlets into the Lohajang, it has two CDOs in the north, the Dannya Chowdhury CDO and the Chillabari CDO. Most of the drainage of the sub-compartment takes place via sub-compartment 11.

There are about 10 beels in the sub-compartment, half of them perennial, half non-perennial. Most of the beels are contained within one single chawk. None of the beels have direct access to outside water. The Singerkona Beel, which is non-perennial, may take water from the Lohajang, via Dannya Chowdhury CDO. The Singerkona Beel has the Singerkona Beel WCS at its downstream side for water level control.

In conclusion, the sub-compartment has no access to water from outside the Compartment. Its drainage structures on the Lohajang only serve the northern parts. For most of its drainage, the sub-compartment is dependent on drainage systems in sub-compartment 11. Water management has to be co-ordinated with that of sub-compartment 11.

Sub-compartment 11

Sub-compartment 11 has two inlets on the Dhaleswari river, the Binnafair and the Fatehpur intakes. The area is drained via the Fatehpur Khal, the Chillabari Khal, which both join the Binnafair Khal, and which changes into the Gaizabari Khal moer downstream. The latter khal drains via the Kagmari outlet into the Lohajang. There are two other drainage systems, one which ends at Dighulia-2 CDO and a smaller one which ends at Dighulia-1 CDO.

Halfway the Binnafair / Fatehpur Khal and the Gaizabari Khal is the Santosh Regulator. If the Santosh regulator is open, drainage flow passes from Cluster 1b into Cluster 4. However, there are other openings in the southern boundary of Cluster 1b, allowing drainage towards Cluster 4.

Most of the chawks have direct access to the drainage system. The only exceptions are chawks along the southern boundary of the sub-compartment, 5E, 6E and 6B. None of these chawks have Project interventions at their boundaries.

There are a few beels, all of them non-perennial.

In conclusion, the sub-compartment receives drainage water from sub-compartment 10. Water management in the two sub-compartments requires co-ordination between the two. In case the Santosh Regulator is operated, co-ordination is required with sub-compartments in Cluster 4. To avoid such complications, most of the drainage flow should be diverted towards the CDOs along the Lohajang.

Because the drainage systems of the sub-compartments 10 and 11 are integrated, the concept of having two different sub-compartments becomes somewhat artificial. For water management purposes, the two sub-compartments should be merged. The disadvantage is, that the new sub-compartment becomes very large. To reduce its size one could split the chawks of the two Dighulia systems. In addition, one could disconnect the Dannya Chowdhury system from the Singerkona Khal and join that area with sub-compartment 9.

CLUSTER 4

Sub-compartment 12

Sub-compartment 12 does not have direct access to drainage outlets on the Lohajang. It can only drain via sub-compartment 14. The most important drainage system is the one of the Indrabelta Khal / Aloa Tarini Khal in the north. It drains the chawks 23A, 23B, 23D, 23E and ends at the Aloaraypara Regulator. Chawk 24C is the only chawk which drains via an offshoot of the Deojan Khal. The other chawks are not connected to systems draining towards the Lohajang

The Barabelta Khal is connected with the Dhaleswari. It is not clear whether this is a drainage or a water intake system. Chawk 24D does not have a clear direction of drainage. It does not have Project interventions along its boundaries.

The sub-compartment has two inlet structures, the Indrobelta sluice and the Barabelta sluice. The first allows water intake into the Indrabelta / Aloa Tarini system, which has a drainage outlet into the Lohajang. The second is connected with the Barabelta Khal, which does not have an apparent outlet.

There are no beels in the sub-compartment.

In conclusion, the sub-compartment is dependent on sub-compartment 14 for its drainage. In the same way sub-compartment 14 is dependent on sub-compartment 12 for its water intake. Water management needs to be co-ordinated between the two sub-compartments.

The function of the Barabelta system is not clear. The direction of drainage in chawk 24D is not clear either.

Sub-compartment 13

Sub-compartment 13 drains via the Baruha Khal, in the north, which enters sub-compartment 14 to join the Deojan Khal system. It crosses the boundary of the sub-compartment at the Burburia WCS.

In the south, there is a second drainage system, which ends at Baria Atia WCS and which crosses the southern boundary of the Compartment. All chawks have more or less direct access to either one of the drainage systems. However, one may expect that conditions downstream of Bara Atia WCS are different from those downstream of the Burburia WCS.

There are no beels in the sub-compartment.

As is the case with sub-compartment 12, sub-compartment 13 needs to co-ordinate its drainage management with sub-compartment 14. In the same way sub-compartment 14 is dependent on sub-compartment 13 for water intake.

Sub-compartment 14

Sub-compartment 14 is drained by two systems, the Aloa Tarini system and the Deojan system. Both systems drain into the Lohajang river at respectively the Aloaraypara Regulator and the Deojan Regulator. They reach the majority of the chawks. Exceptions are the chawks along the southern boundary of the Compartment, which have an independent drainage system crossing the southern boundary of the Compartment at Kandoor GPC.

The most dominant beel in the sub-compartment is the Kumuria Beel, which is part of the Deojan drainage system. It is a perennial beel, which extends into several chawks. There is a smaller beel north of it, which is also perennial and part of the Deojan system. If water levels in these beels are manipulated, it will affect drainage conditions in the chawks upstream, extending even into the sub-compartments 12 and 13.

The three sub-compartments 12, 13 and 14 have interrelated water intake and drainage systems. This renders co-ordination about water management difficult. An alternative is to create two new sub-compartments, one for the Indrabelta / Aloa Tarini system and one for the Baruha / Deojan system. The position of the Barabelta system would depend on the direction in which the chawks of the system drain.

The chawks in the south, draining across the Compartment boundary could be made into separate sub-compartments. Their drainage systems are independent and hydrological conditions are different from those in the other chawks.

Sub-compartment 15

Sub-compartment 15 has a number of small systems, partly draining across the Compartment boundary, partly draining into the Lohajang. It is likely that there is not much difference in drainage conditions between the two kinds of systems at this location in the Compartment. There are four WCS/GPC, Pathrail, Kumuli,

Khagjani and Birpusia. Water management takes place in small more or less independent units of only one or two chawks. As far as water management is concerned, there is no great need for a SCWMC.

There are a few small perennial beels and a non-perennial beel. All contained within a single chawk. In addition, there are perennial fish ponds in the area.

CLUSTER 2
Sub-compartment 8

Sub-compartment 8 contains a number of chawks, in the west, along the Lohajang, which do not have an apparent drainage system. The only chawk with a drainage system and a WCS is chawk 9E with the Dharerbari WCS. The remaining chawks drain towards the District Regulator. The District Regulator has a capacity problem, while it is located close to the urban area of Tangail. As a matter of policy, it would be advisable to stimulate drainage directly into the Lohajang to reduce drainage congestion at the District Regulator.

The only drainage system of importance in the sub-compartment, is the Bamni Khal, which drains towards Enayetpur WCS-2, from where the water flows to the District Regulator via the District Khal.

Sub-compartment 8 has no beels. Neither has it facilities to take water in, with the exception of the Dharerbari WCS. As will be explained, the sub-compartment is dependent on conditions in the sub-compartments 7 and 6 as far as drainage is concerned.

Sub-compartment 7

Sub-compartment 7 has a rather intensive drainage system, which provides direct access to drainage for most of its chawks. Exceptions are the chawks 10A and 10H, which have Project interventions, Batchanda WCS-1 and 2 on their boundaries but no apparent drainage system.

Sadullapur Khal has inlet facilities. The Sadullapur Regulator may take water in from the Gala Khal in the north, which belongs to the outside water. There are beels in chawk 10J. They can be supplied with water from Sadullapur. The procedure is, to close the District Regulator and to open Sadullapur and the Magurhata WCS. As the system, controlling the water levels in the beels, does not have upstream extensions, one may expect that water levels in the beels have minor effects on drainage conditions in other chawks.

Enayetpur WCS-2 plays an important role in the water management of the cluster. If the structure is closed, water from the east can not drain via the District Regulator, but instead, it is expected to flow via the southern extension of the Sadullapur Khal into Cluster 3. That may be desirable from the viewpoint to relieve drainage congestion at the District Regulator, it complicates co-ordination of water management procedures. By draining into Cluster 3, water management of the clusters 2 and 3 becomes interrelated.

An alternative policy would be, to reduce the drainage flow from the west, from sub-compartment 8 towards Enayetpur as much as possible. That could be done by providing the chawks along the Lohajang with outlets into that river, as mentioned before. At the same time, as will be discussed in the next section, sub-compartment 5 and part of sub-compartment 6 could be disconnected from the southern branch of the Sadullapur Khal.

Drainage conditions at Enayetpur, in the District Khal and at the District Regulator are under influence of the water management in the sub-compartments 8, 7 and 6. A complicating factor, are drainage conditions in nearby Tangail Town. In terms of drainage priorities, urban areas usually have priority over agricultural areas. That is another reason to limit drainage flow towards Enayetpur from the west, as much as possible.

In the guidelines for the SCWMCs of the three sub-compartments, the priorities for urban and agricultural areas should be clearly stated.

Sub-compartment 6

Sub-compartment 6 is drained via the Rasulpur Khal system, which reaches most of the northern chawks of the sub-compartment. The downstream section of Rasulpur Khal may drain into two directions: either towards Enayetpur or via Sadullapur Khal into Cluster 3. To further reduce the drainage flow towards Enayetpur, the southern branch of Sadullapur Khal could be disconnected from the Rasulpur Khal, while the boundary between Cluster 2 and 3 would move up along the line Enayetpur towards the northern boundary of the chawks 11J and 13A.

Rasulpur Khal has an inlet from the Gala Khal at the Rasulpur Regulator. It is the only inlet of the sub-compartment. There are some minor beels, which do not have direct access to outside water. Neither are they in the path of drainage systems. Maintaining higher water level in these beels is not expected to affect drainage conditions in upstream areas to a large extent.

Sub-compartment 5

Sub-compartment 5 drains via its southern boundary into cluster 3 via Garinda Regulator. There is another Project intervention along that boundary, namely Beel Garinda WCS. On the other hand, the boundary between the clusters 2 and 3 has many ungated openings. It is not known to what extent the mentioned Project interventions allow control of water levels and water flow.

As mentioned in the previous section, water management in cluster 2 would be much simpler, if the boundary between cluster 2 and 3 would be shifted to the north, while disconnecting the southern branch of Sadullapur from the Rasulpur Khal.

The sub-compartment has an inlet / outlet at Bararia sluice but no apparent system connected to it. There is one minor beel in chawk 12 A, which is not connected to an apparent water system.

Remaining remarks

The shortage of drainage capacity in cluster 2 is not caused by the revision of sub-compartment boundaries. It would still be there without such reorganisation. Works to remedy the situation are rather extensive and costly. The proposal is to collect more information about how the system actually functions, during the coming monsoon, before making any designs.

Design work should be started, if construction funds have ben secured.

CLUSTER 3

Sub-compartment 4

The Garinda Jalfai Khal runs through the sub-compartment from north to south and ends at Jalfai outlet along the Lohajang. It provides most of the chawks with access to the drainage system. Exceptions are chawk 22D in the south east and the chawks 22G, 22H and 22J in the southwest. The latter three chawks have one single Project intervention, Mirer Betka WCS, towards an offshoot of the Garinda Jalfai Khal.

Chawk 22B contains two perennial beels, Garinda Beel and Darun Beel. The latter is connected with the Tangail drains which runs through the Tangail urban area. As chawk 22B is rather large while its drainage system seems to run through Tangail Town, it seems advisable to disconnect the drainage of the chawk from the Tangail drain and divert the drainage towards the Garinda Jalfai system. In this way interference between urban drainage and agricultural drainage can be avoided.

The Garinda Jalfai system seems to receive water from sub-compartment 3 via Golabari Khal. However, as will be discussed in the next section, the chawks in the north of sub-compartment 3 appear to be draining towards the south and not towards sub-compartment 4.

Sub-compartment 4 receives drainage water from sub-compartment 3 at still another location namely at Poila WCS, located on the western boundary of chawk 20A. As that boundary is a sub-compartment boundary, the structure complicates water management matters. Alternatives to avoid such complications are, either to keep the drainage water from chawk 20A inside sub-compartment 3 by giving the chawk another outlet, or to join the chawk with sub-compartment 4.

Sub-compartment 4 does not have an independent access to outside water, unless via cluster 2 or via the Suruj inlet and Suruj / Golabari Khal in the sub-compartments 3 and 1.

The most important perennial beels are Garinda Beel and Darun Beel. Neither has direct access to outside water. There a number of minor non-perennial beels in the sub-compartment.

Sub-compartment 3

Sub-compartment 3 has two major drainage systems, the Suruj Golabari Khal and the Bhatkura Khal. The former system is connected to the Garinda Jalfai system, but the hydrology map of the sub-compartment shows a drainage flow going south. However, the southern branch of the Suruj Golabari Khal stops at the boundary between chawks 19C and 19E and does not continue southwards. The Suruj Khal has direct access to outside water from the Pungli river at Suruj inlet, which is located in sub-compartment 1.

The other drainage system is the Bhatkura Khal, which ends at the Bhatkura Outlet along the Lohajang.

The sub-compartment receives drainage water from the sub-compartments 1 and 2. There are a number of Project interventions along its eastern boundary.

A rather large part of the area of sub-compartment 3 is occupied by beels, most of them non-perennial. The only perennial beel is Hatia Beel in the centre, where the Suruj Golabari drainage system ends. Hatia Beel has direct access to the Pungli water. However, water levels in the Hatia Beel will affect drainage conditions in the upstream chawks.

Chawk 21A has an independent outlet into the Lohajang at Khudirampur WCS.

Sub-compartment 1

Sub-compartment 1 is a small sub-compartment and for water management reasons it could be easily merged with sub-compartment 3. All its chawks have to drain towards sub-compartment 3 unless drainage is possible towards the Pungli. Drainage conditions along the Pungli, however, are expected to be less favourable than those along the Lohajang. There are no beels.

Sub-compartment 2

What has been said about sub-compartment 1, also applies to sub-compartment 2, at least the northern part. The southern chawks have independent system which drain across the boundary of the Compartment. There are a number of Project interventions, Karatia Choudhurypara WCS, Karatia WCS and Paschim Pauli Regulator. There are no inlets and no beels.
The sub-compartment

Looking at the whole of the sub-compartment, water management could be simplified if the following guidelines are observed:

Disconnect the water system of agricultural areas from the Tangail Town systems as much as possible.
Disconnect the Golabari Khal from the Garinda Jalfai Khal and give the sub-compartments 3 and 4 two independent water systems.
Join sub-compartments 1 and 2 with sub-compartment 3, so that water systems can be integrated.
To avoid that the new sub-compartment 3 becomes too large, disconnect the chawks which drain independently namely the chawks 21A, 18A, 18B, 18C, 17B and possibly 17A and 16B. Those could be

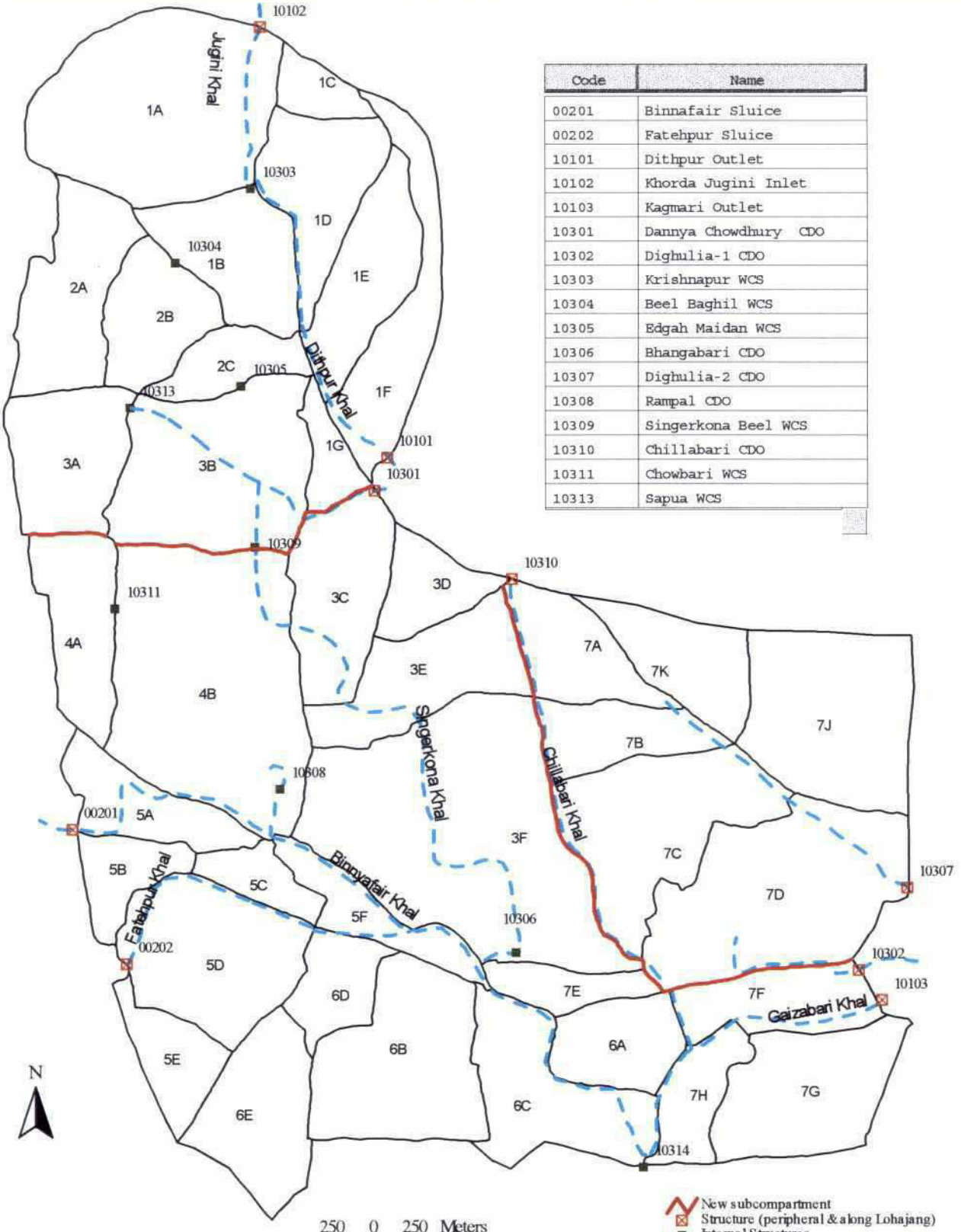
merged into a new sub-compartment. However, as most chawks drain independently, there is no great need for the establishment of a sub-compartmentWMC, as far as water management is concerned.

FINAL REMARKS:

The Figures A1 - A5 contain a number of alternatives, but there are many more. One alternative that should be given attention is, to make every independent drainage system into a sub-compartment, in order to avoid that land users of neighbouring sub-compartments have decision power over systems to which they do not belong.

There are a number of obvious cases, which can quickly be implemented. Other case may have to wait until decisions to change boundaries have found sufficient support.

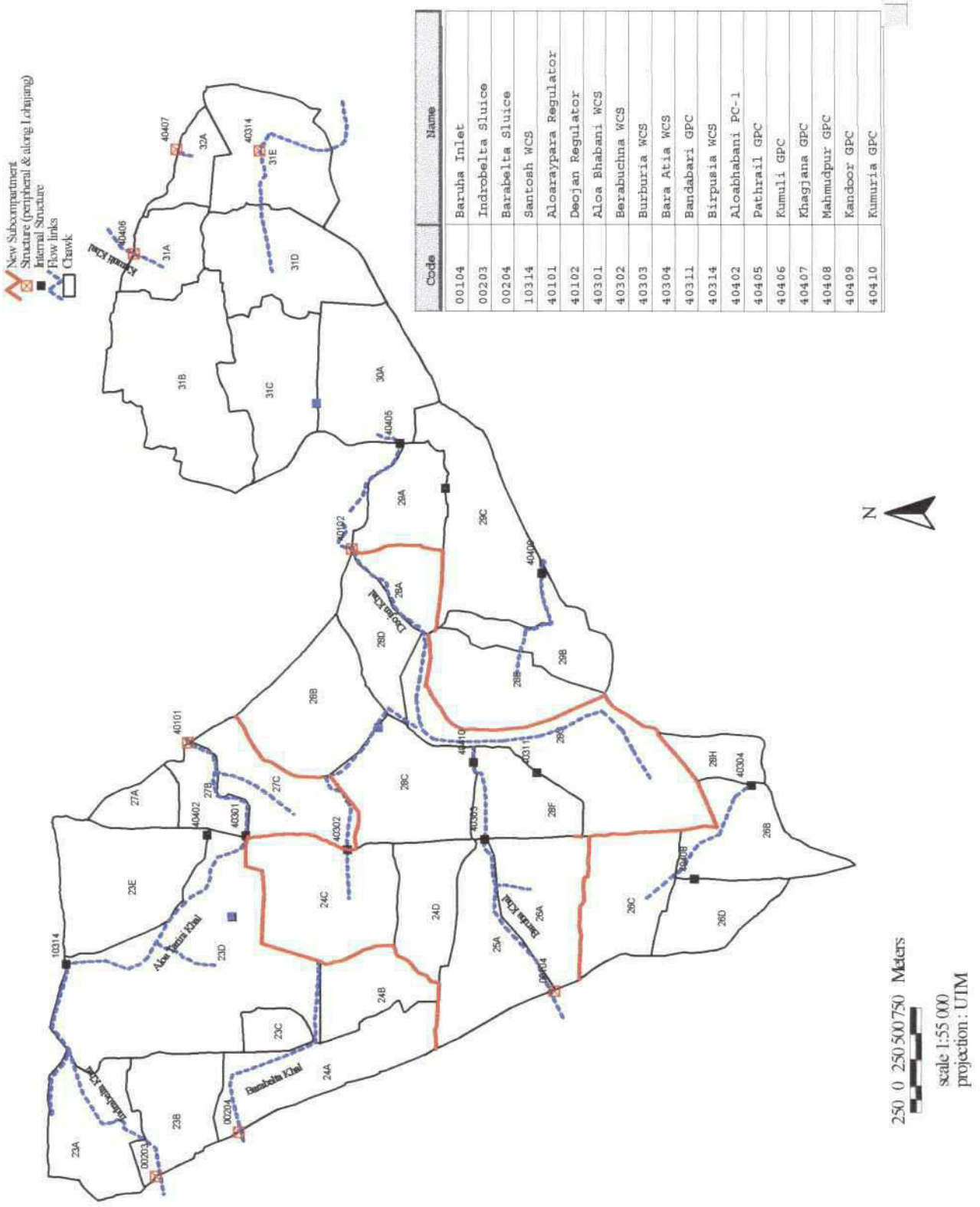
Fig A.1 Internal Infrastructure Cluster1b, NEW SC BOUNDARIES



Code	Name
00201	Binnafair Sluice
00202	Fatehpur Sluice
10101	Dithpur Outlet
10102	Khorda Jugini Inlet
10103	Kagmari Outlet
10301	Dannya Chowdhury CDO
10302	Dighulia-1 CDO
10303	Krishnapur WCS
10304	Beel Baghil WCS
10305	Edgah Maidan WCS
10306	Bhangabari CDO
10307	Dighulia-2 CDO
10308	Rampal CDO
10309	Singerkona Beel WCS
10310	Chillabari CDO
10311	Chowbari WCS
10313	Sapua WCS

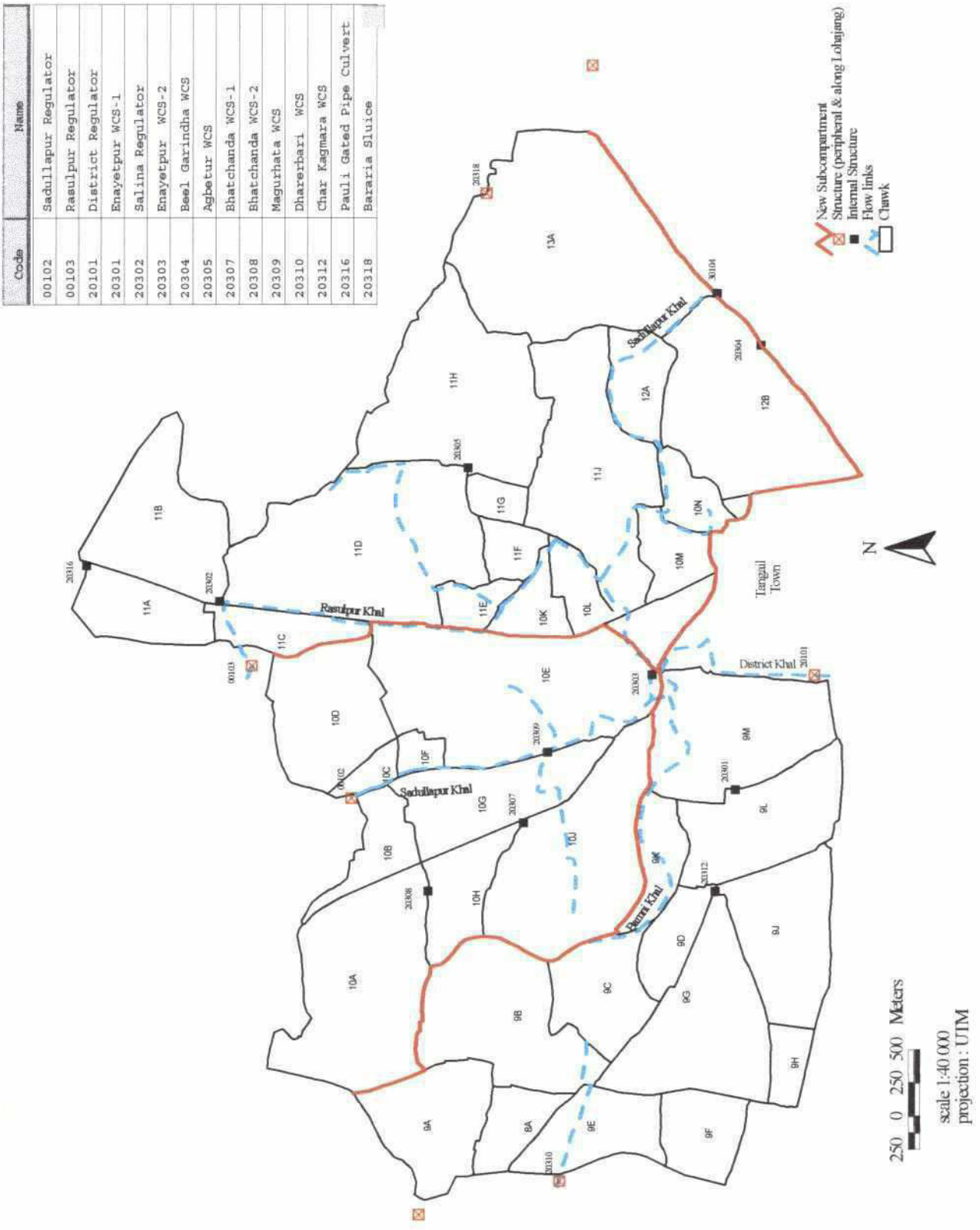
Compartmentalization Pilot Project Tangail

Fig A.2 Internal infrastructure Cluster4, NEW SC BOUNDARIES



Compartmentalization Pilot Project Tangali

Fig A.3 Internal Infrastructure Cluster2, NEW SC BOUNDARIES ALT. 2



Compartmentalization Pilot Project Tangail

Fig A.5 Internal Infrastructure Cluster2, NEW SC BOUNDARIES ALT. 1

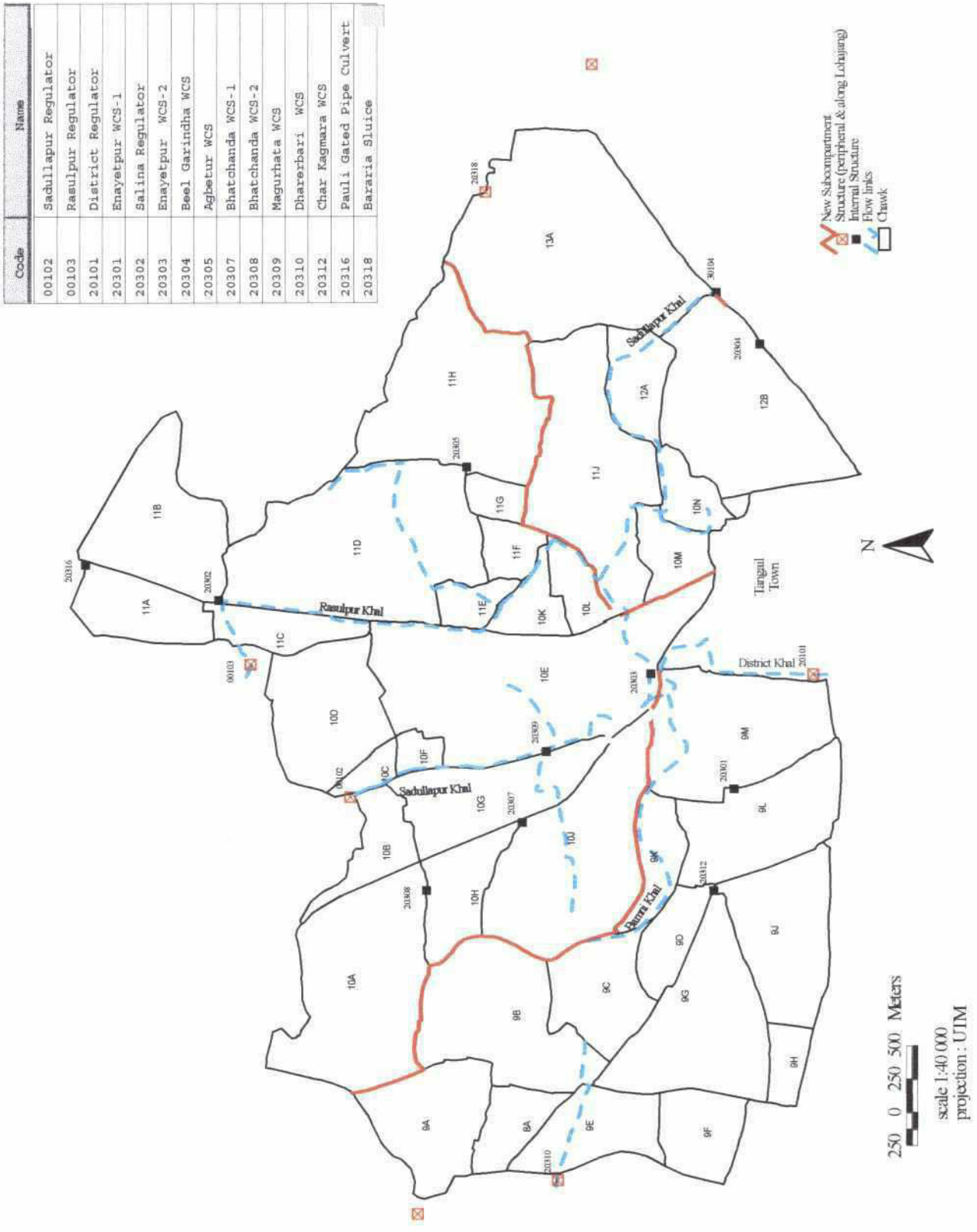
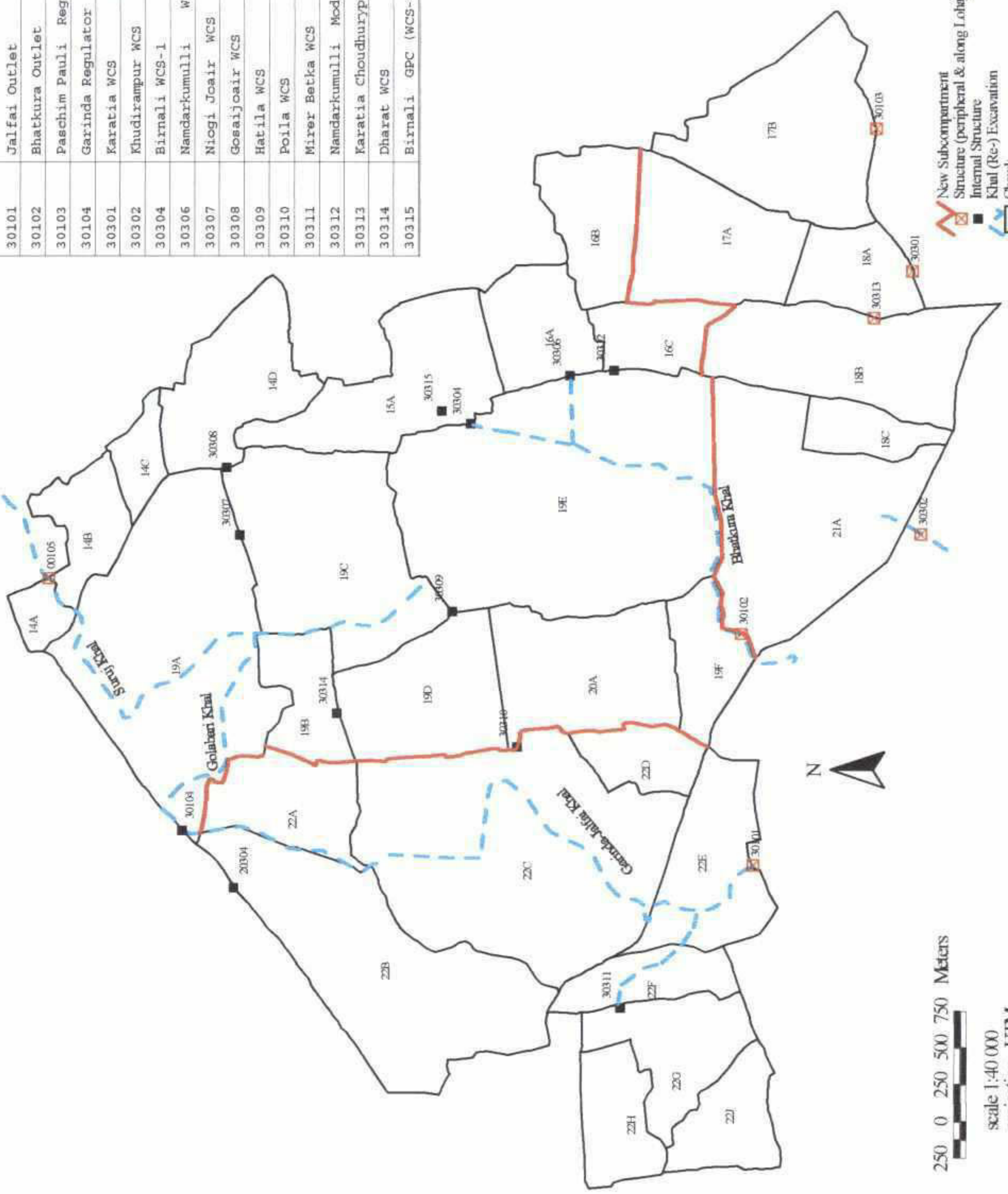


Fig A.5 Internal infrastructure Cluster3, NEW SC BOUNDARIES

Code	Name
00105	Suruuj Inlet
20304	Beel Garinda WCS
30101	Jalfai Outlet
30102	Bhatkura Outlet
30103	Paschim Pauli Regulator
30104	Garinda Regulator
30301	Karatia WCS
30302	Khudirampur WCS
30304	Birnali WCS-1
30306	Namdarkumulli WCS
30307	Niogi Joair WCS
30308	Gosaijoair WCS
30309	Hatila WCS
30310	Poila WCS
30311	Mirer Betka WCS
30312	Namdarkumulli Moddhy. WCS
30313	Karatia Choudhurypara WCS
30314	Dharat WCS
30315	Birnali GPC (WCS-2)



APPENDICES TO

ANNEX 1A

APPENDIX 1: REVISION OF SUB-COMPARTMENT BOUNDARIES

APPENDIX 2: TASKS JUNIOR WATER MANAGEMENT OFFICER (JWMO)

APPENDIX 3: LIST OF GAUGES TO BE MAINTAINED

APPENDIX 2: TASKS JUNIOR WATER MANAGEMENT OFFICER (JWMO)

1. Have discussions with land users at chawk level about water management problems and practices.
2. Attend SCWMC meetings and stimulate that such meetings are held according to the agreed schedule
3. Under supervision of the Water Management \ Drainage Engineer, establish contacts with extension workers in the field.
4. Report weekly about contacts with land users to the CPP Water Management \ Drainage Engineer.
5. Assist in the process of SCWMCs writing bye-laws and procedures with support of other Project staff.
6. Assist Project Staff in writing manuals and operation procedures for the internal infrastructure of the sub-compartment.
7. Train WUGs in the Project's operational procedures.
8. Collect complaints about water management at chawk level and report about them.
9. Supervise the collection of gauge readings by the SCWMCs and take care that the readings reach the CPP office every week.
10. Draft proposals for minor works and discuss these with the WUGs. Minor works are works at chawk level.
11. Assist in drafting and processing requests for the execution of minor works.
12. Assist during the implementation of minor works and see to it that WUGs receive assistance if they need to.
13. Stimulate the execution of minor maintenance, such as greasing and painting of gates, minor soil work etc, under the responsibility of the SCWMCs.

APPENDICES TO

ANNEX 1A

APPENDIX 1: REVISION OF SUB-COMPARTMENT BOUNDARIES

APPENDIX 2: TASKS JUNIOR WATER MANAGEMENT OFFICER (JWMO)

APPENDIX 3: LIST OF GAUGES TO BE MAINTAINED

APPENDIX 3: LIST OF GAUGES TO BE MAINTAINED

1. Gauges along the boundaries of the Compartment

1.1 The main regulator upstream. There is an existing gauge SG01, which started being read July 1995.

1.2 Binnafair or Fatehpur inlet, upstream. The intention is to measure water levels in the Dhaleswari river. Binnafair is probably best.Gauge SG03 started to be read there since July 1995.

1.3 Barabelta inlet, upstream. Gauge G10 started to be read since July 1993.

1.4 Gauge G12, measures water levels in the Elanjani, at the southern border of the compartment. The gauge started to be read in May 1995.

1.5 Rasulpur, gauge G28 measures water level in the Gala khal. The gauge has been read since June 1992.

1.6 Suruj. New gauge. The intention is to read water levels in the Pungli river.

1.7 Gauge G14, measures water at the southern border of the compartment in the Pungli river. The gauge has been read since June 1992.

2. Gauges along the Lohajang

2.1 Gauge downstream of the main regulator. There is an existing gauge SG02, which started to be read in July 1995. At present there is a sand bar downstream of the Main Regulator and water level readings are not representative for the Lohajang. As long as this is the case water levels should be measured at Dithpur. There is an existing gauge downstream of Dithpur SG08, which started to be read in July 1995.

2.2 Gauge downstream of District regulator. There is an existing gauge G02, at Tangail town. The gauge has been read since June 1992. This gauge should be maintained.

2.3 Gauge downstream of Aloa Raypara. There is an existing gauge G04, which has been read since July 1995.

2.4 Gauge downstream of Nagar Jalfai. There is an existing gauge G06, which has been read since June 1991.

2.5 Gauge downstream of Karatia in the Lohajang. There is an existing gauge G08, which has been measured since May 1991.

3. Internal Gauges

CLUSTER 1b

3.1 Gauge upstream of Dithpur. There is an existing gauge SG07, which has been read since July 1995.

3.2 Gauge upstream of Rampal. There is an existing gauge SG27, which has been read since July 1995.

3.3 Gauge upstream of Bangabari. There is an existing SG25, which has been read since July 1995.

3.4 Gauge upstream of Santosh. There is an existing SG13, which has been read since July 1995.

3.5 Gauge upstream of Kagmari. There is an existing SG11, which has been read since July 1995.

CLUSTER 2

3.6 Gauge upstream and downstream of Enayetpur regulator. Probably existing gauge (G30), which was read since June 1992.

3.7 Gauge upstream of District regulator. New gauge. Reading to be combined with the one under 2.2 above.

3.8 Gauge upstream of Garinda. There is an existing gauge G31, which has been read since May 1991. One should check whether the reading is representative for the future Garinda regulator.

CLUSTER 3

3.9 Gauge upstream of Nagar Jalfai. New gauge to be combined with readings under 2.4 above.

3.10 Gauge upstream of Bhatkura regulator. New gauge.

3.11 Gauge upstream of Karatia. New gauge. Reading to be combined with the one under 2.5.

CLUSTER 4

3.12 Gauge upstream of Aloa Raypara. New gauge. Reading to be combined with reading under 2.3 above.

3.13 Gauge upstream of Deojan. New gauge.

3.14 Gauge upstream of Kumulli or Khagjana (Fusukia). New gauge.

3.15 Gauge upstream of Kandor. New gauge.

Government of the People's Republic of Bangladesh
Ministry of Water Resources
Bangladesh Water Development Board
Water Resources Planning Organization

COMPARTMENTALIZATION PILOT PROJECT, TANGAIL

Final Phase

INCEPTION REPORT

VOL 2: ANNEX 1 : SECTORAL ANALYSIS -AN OVERVIEW
VOL 2: ANNEX 1A : WATER MANAGEMENT / ENGINEERING
1B : AGRICULTURE ←
1C : FISHERIES
1D : ENVIRONMENT
1E : INSTITUTIONS (INTER-ORGANIZATIONAL)
1F : WOMEN IN DEVELOPMENT
1G : MONITORING & EVALUATION/ECONOMICS
VOL 2: ANNEX 2 : EXECUTIVE SUMMARY REFORMULATION MISSION REPORT (OCT. 1995)
VOL 2: ANNEX 3 : TOR CPP FINAL PHASE
VOL 2: ANNEX 4 : MoU DONOR REVIEW MISSION

April 1997

LAHMEYER INTERNATIONAL GMBH, Germany

in Association with

Haskoning - Consulting Engineers & Architects, The Netherlands
Consultants for Development Programmes (CDP), The Netherlands
Development Design Consultants Ltd. (DDC), People's Republic of Bangladesh

Donors:

Directoraat Generaal Internationale Samenwerking, Government of the Netherlands

and

Kreditanstalt für Wiederaufbau, Federal Republic of Germany

TABLE OF CONTENTS

ANNEX 1B: AGRICULTURE **5**

1. THE AGRICULTURE PROGRAMME (1997-2000) **5**
1.1. Objectives of CPP in relation to agriculture 5
1.2. Land types and land use 5
1.3. Implications of project interventions for agriculture 6
1.4. Objectives of the agricultural programme 7
1.5. Activities of the agricultural programme 7
1.6. Implications for some on-going and planned activities 15
1.7. Institutional co-operation 16
1.8. Organizational issues 16

2. DETAILED WORKPLAN, PERSONNEL REQUIREMENT AND BUDGET **18**

LIST OF FIGURES

Figure 1.1: Dominant crop calendar by land types and flooding depth 6
Figure 1.2: Shift in monsoon landuse 1996 vs. monsoon landuse 1993 10
Figure 1.3: Location of monitoring plots 11
Figure 1.4: Three selected pilot OFTD-chawks 14
Figure 2.1: Detailed workplan, personnel requirement and budget : Agriculture 19

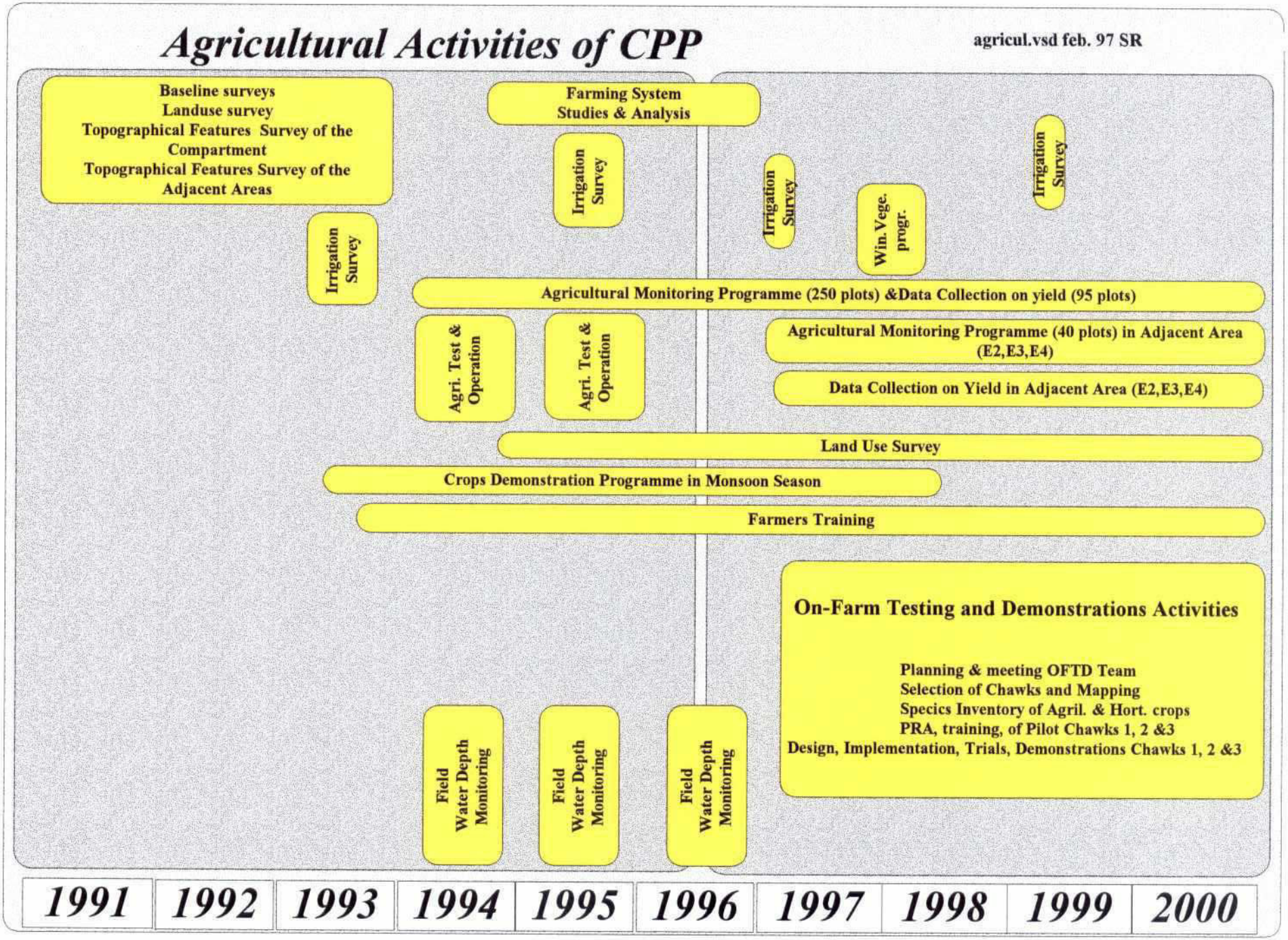
LIST OF APPENDICES

APPENDIX 1: LANDUSE SURVEY 21
APPENDIX 2: MONITORING PLOTS 23
APPENDIX 3: METHODOLOGY FOR OFTD IN THE PILOT CHAWKS 25

Agricultural Activities of CPP

Agricultural Activities of CPP

agricul.vsd feb. 97 SR



ANNEX 1B: AGRICULTURE

1. THE AGRICULTURE PROGRAMME (1997-2000)

1.1. Objectives of CPP in relation to agriculture

Improved water management inside the compartment aims at a number of changes in hydrological conditions in different phases of the annual hydrological cycle:

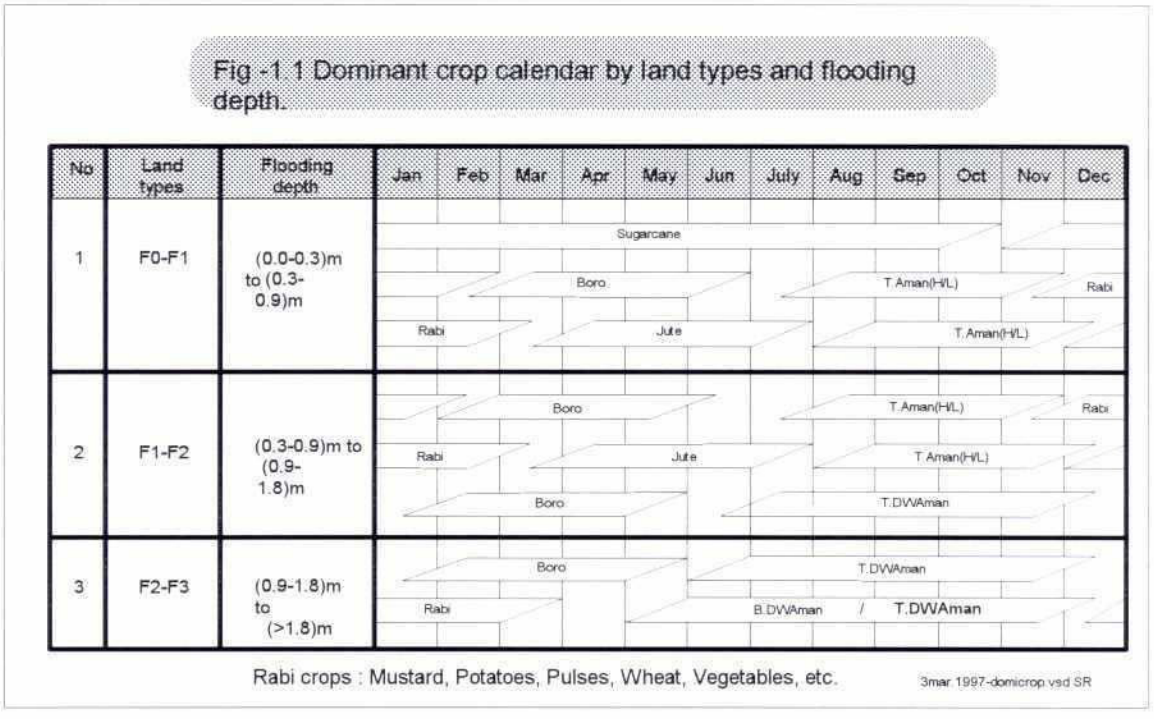
- controlled flooding in the pre-monsoon season by capturing and distributing early increases in river flow, allowing (i) deposit of silt carried by the rivers, (ii) restocking of fish populations
- adequate drainage in the pre-monsoon season to reduce damage by flooding to standing mature boro rice and to B-DW aman seedlings
- reduced flooding depths (changes in land types) during the monsoon by reducing the inflow into the compartment and by improved water management inside the component, thus allowing a shift in monsoon rice production to HYV-aman
- earlier evacuation of water from the compartment by improved drainage, allowing earlier planting of rabi crops

1.2. Land types and land use

Land types have been defined on the basis of flooding depths during the Kharif-II season. Five land types are distinguished (F_0-F_4), the first four of which occur in the CPP area in the absence of project interventions. Monsoon land use of periodically flooded fields is determined by the usual flooding depth and each land type corresponds with a few typical cropping patterns (fig. 1). Part of the F_0 land type is only flooded under exceptional conditions and it is typically used for homesteads gardening, orchards and dry land crops, especially vegetables. In the project's mapping of land types, this distinction should be made.

Rabi ('winter') crops are grown in the dry season, especially mustard, wheat and potatoes etc largely on residual moisture. They are important cash earners in addition to jute. which is grown in the pre-monsoon season and annual sugarcane with a full year cycle. With the application of dry season irrigation through deep and shallow tube wells boro has become a major rice crop in terms of total production.

Figure 1.1: Dominant crop calendar by land types and flooding depth.



1.3. Implications of project interventions for agriculture

The implications of improved water management for agricultural production may be looked at from three perspectives:

a) effects on the seasonal growing conditions in the different land types; and
b) effects on the options farmers have, for using their land and on the productivity of farming

These effects are briefly analysed on the basis of existing project information, as a point of departure for the agricultural programme.

a) Effects on seasonal growing conditions

Pre-monsoon season (Kharif-I) : By the controlled intake and distribution of early flood water, it is expected that some pre-irrigation becomes possible, while inundation of low-lying areas can be delayed. Improved drainage should reduce the accumulation of excess water from early rain-storms. This should reduce damage to the standing Boro rice crop and facilitate its harvest as well as preventing damage to young DWaman seedlings.

Monsoon season (Kharif-II) : Better water control will result in an overall decrease in water levels during the Kharif-II season. This is expected to entail a shift in the distribution of land types, based on 'normal flooding depth' in Kharif II towards less deeply inundated land types[1].

Post-monsoon and Rabi season: Improved drainage should result in early land availability for dry season crops.

[1] It should be noted here that CPP can only be tested on a stand-alone basis. The physical and hydrological situation in a multi-compartment setting is probably substantially different.

If the expected change in land type distribution materializes, this would have a profound effect on farmers options for cropping.

The major effects would be :

1. dry land crops can be planted earlier, allowing a larger area to be planted to typical winter crops like mustard, wheat, potatoes and increasing the scope for two successive rabi crops (now usually mustard and boro)

2. better drainage should reduce early flooding, resulting in:
   - reduced risk of damage to the standing boro crop
   - more favorable conditions for transplanted and direct seeded Kharif rice

3. lower water levels in the Kharif season should increase the scope for planting high yielding to aman instead of deep water aman and planting of deep water aman in previously deeply inundated land, which was left fallow.

The third effect is the most uncertain and there will be increased risk associated with a change-over in Kharif rice grown. In those areas where decreased flooding depth can be reliably expected, rice production is likely to increase because of a shift to more productive monsoon rice growing practices. This should reduce the reliance on boro rice and opens opportunities for other irrigated rabi crops to replace boro. A shift to rabi crops other than boro is considered desirable because of GoB's policy to diversify agricultural production and because of the assumed profitability of either crops. Alternative irrigated rabi crops would be a real innovation, but economic and marketing issues need attention.

1.4. Objectives of the agricultural programme

The goal of the agricultural programme is to :

"testing of the agricultural production potential with controlled flooding".

The activities of the cultural programme should follow strictly from its goals and objectives:

1. monitoring the actual changes in seasonal growing conditions and in farmer's landuse as a result of the project's flood control and drainage interventions
2. exploring with the farmers new options for crop production, including new cropping patterns, alternative rabi crops and more productive rice production methods and varieties in the Kharif season.

1.5. Activities of the agricultural programme

The proposed activities of the agricultural programme are derived from its goals and objectives. The activities are grouped into two overall themes:

- *monitoring the changes in field conditions and the evolution of farmers' cropping practices and yields.* The aim is to assess the effect of changing water management conditions on agriculture in the compartment
- *participatory assessment of new options for cropping practices, cropping patterns and diversification of crops.* The aim is to assist farmers in identifying and implementing new options for farming, made possible by the improved water management conditions

In the following paragraphs the rationale for each theme will be examined followed by an analysis of what is currently done by CPP. Finally the proposed activities of the agricultural programme are outlined. Some methodological details are described in the Annexes.

Theme I: monitoring field conditions, cropping practices and yields

Rationale

The project's improved water management is expected to result in changes in farmers' landuse and cropping patterns if they feel confident enough about these effects. This should lead to increased rice production in the monsoon and increased crop diversification in the dry season. Monitoring of landuse practices will have to continue for a considerable time before significant changes are likely to be observed. The reasons are (i) the magnitude of year-to-year variation in rainfall and flooding conditions which are superimposed on any trend in farmers' changing strategies and (ii) the time farmers will need to build up confidence before they will make drastic changes in their cropping pattern.

Current CPP approach and methodology

The current CPP approach to monitor farmers' landuse practices and collect economic information consists of three components:

- an annual detailed monsoon *landuse survey*, which maps agriculture landuse in the entire compartment in October - December (Figure 1.2)
- *monitoring plots* inside the compartment and 40 plots in the northern adjacent area which are visited monthly, to record the current crop and the field water level (Figure 1.3)
- out of the 250 monitoring plots inside the compartment and 10 out of the 40 adjacent, information is collected on *inputs and yields*, based on farmer recall

Landuse survey : Since 1996 CPP collects quantitative information on landuse in the monsoon season for the entire compartment. This is done by sketching the areas under different crops in each chawk into a chawk map. The survey is carried out in October - December.

Monitoring plots : In 250 monitoring plots within the compartment and in 50 plots outside, landuse is monitored on a monthly basis to obtain information on cropping patterns and their evolution. The 250 plots are scattered over the entire compartment, their numbers in each sub-compartment corresponding with the sub-compartment's relative size.

Analysis of inputs and yields : Out of the 250 monitoring plots, 50 have been used for monitoring of inputs and yields of different kharif season crops, based on farmer recall. The information on yield collected in the last three years do not have the desired accuracy level due to low sample sizes. Out of the 50 plots in the adjacent area 10 are used for input/output monitoring . From the above reason it is clear that the accuracy of these observations in estimating mean yields will be very low.

Current DAE approach and methodology :

Monitoring farmers cropping patterns and crop yields is also a major official task of the Department of Agricultural Extension (DAE). DAE has about 45 Block Supervisors (BS) in CPP area (representing 20% of the area of Tangail District), each covering on average 2-4 chawks. All BS collect information on crop areas from a sample of farmers in their block, based on recall and on 'visual estimation'. They also carry out crop cuts for yield measurement in 3 fields per block for each crop ('good', 'medium' and 'low' yielding plots). In order to compare their figures with those of the project, the Extension Blocks inside the compartment must be identified and the area and yield data measured per Block have to be obtained.

Summing up, the two organisations' (CPP and DAE) current data collection schemes include the following elements:

- *crop areas* in all cropping seasons; DAE collects these through farmer interviews and visual inspection, CPP through visual chawk-level mapping, sofar only at the end of the monsoon
- *cropping patterns*, not inventoried by DAE; CPP monitors cropping patterns in 250 monitoring plots
- *mean yields* of all crops; DAE carries out crop cuts for all major crops, CPP only estimates yields of monsoon crops from farmer recall in a subset of 50 plots from the 250 monitoring plots
- *input/output* assessment for economic analysis of monsoon crops; CPP only, through farmer interviews in 50 monitoring plots.

In principal, the information collected by DAE comes close to the requirements of CPP, except for cropping patterns which are not recorded. CPP collects largely the same data using a different methodology and does not make use of the DAE data. Doubts exist about the reliability of the DAE data, but they do not look unreasonable. Furthermore, CPP being a temporary construct, which will cease to exist in the future, it should work as much as possible through existing institutions to ensure sustainability and future continuation of its activities. So, it is proposed as a start, that monitoring of landuse becomes a joint activity of CPP and DAE.

Proposed agricultural activities for Theme I, 1997-2000

The following activities will be carried out as part of the monitoring theme:

1. *Monitoring the evolution of land use* in the CPP area through two chawk -level mapping rounds annually, in April/May and in October/November. The DAE Block Supervisors should gradually take over these surveys, with training and supervision from CPP personnel (Appendix I). If this is successful, a third survey could be considered in January, to obtain the full picture of year around cropping. This last survey will be less time consuming and more precise.

2. *Monitoring cropping patterns* in the 250 monitoring plots inside the compartment and in the adjacent areas; through four to six observations annually scheduled according to season instead of the current monthly visits; maximum water levels should be observed on 15th-20th July and in August every year.

3. *Monitoring yields of monsoon rice* crops through farmer recall, in 15-30 plots *per crop* from the set of 250 monitoring plots (Appendix 2).

4. *Collection of input and output data* The data are needed for the economic analysis of monsoon farming practices in the compartment and the information should be collected through farmer interviews carried out by the economics section.

5. ***Assessing the reliability of farmer recall*** through a comparison of yields obtained by crop cuts and by farmer recall.The agricultural section should carry out this investigation using a sample from the monitoring plots (see Appendix 3)

Theme II : participatory assessment of new cropping options

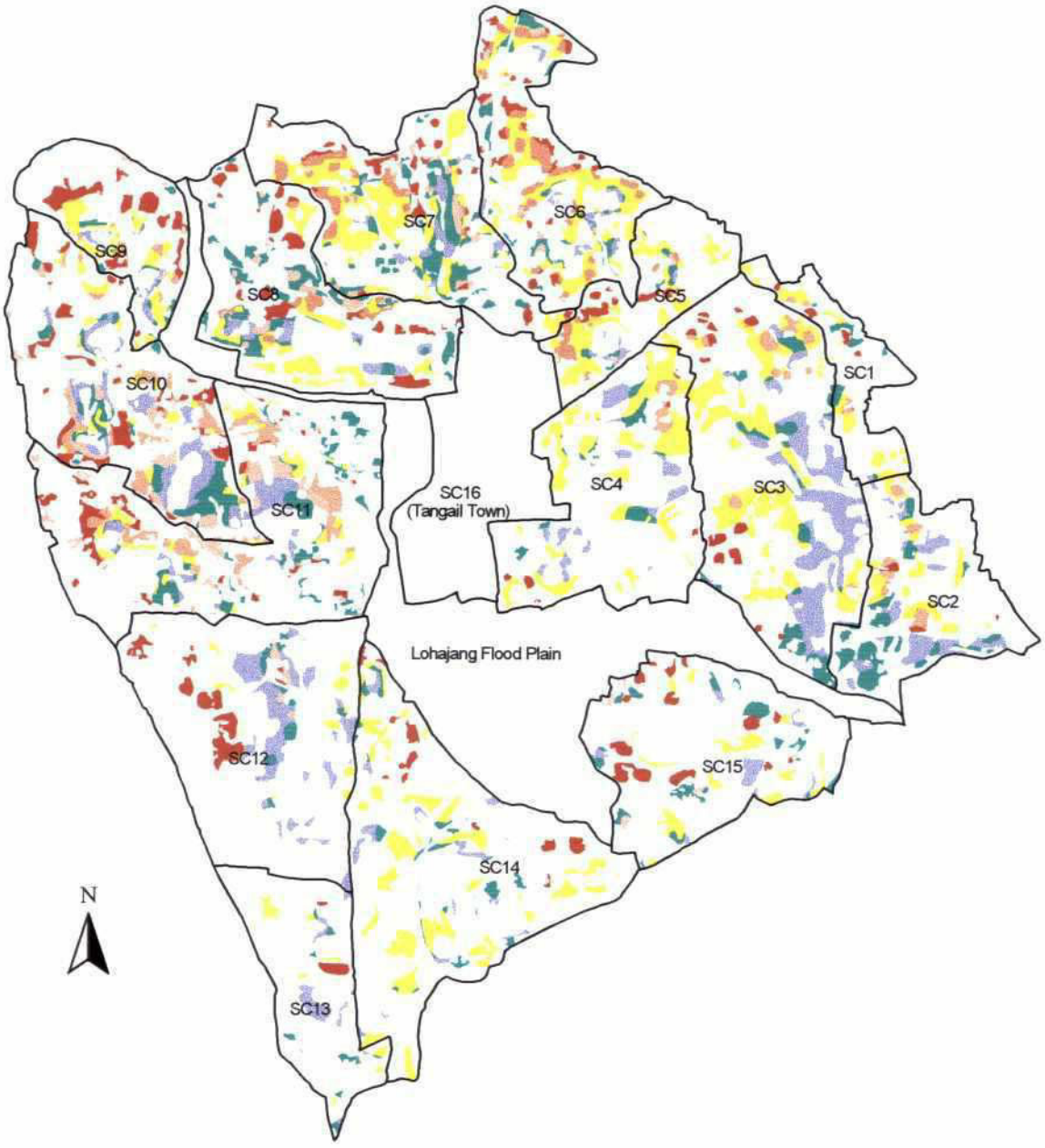
Rationale

CPP's interventions in water management are expected to open new avenues to farmers to increase the efficiency, variety and profitability of their farming operations. However, CPP is a pilot testing programme for integrated water management and the actual physical and institutional performance of the compartment is far from clear. This is also the case with the implications for farming and it is impossible to give reliable predictions and recommendations for improved cropping patterns and practices without a period of testing, covering a range of conditions under the new water management system. Action research is therefore needed with strong farmer participation to explore novel options in cropping practices, varieties, cropping patterns, crop diversification, fertility management,etc,over a sufficiently long period.

Figure 1.2: Shift in monsoon landuse 1996 vs. monsoon landuse 1993

Fig 1.2 Shift in Monsoon Landuse 1996 vs. Monsoon Landuse 1993

Shift (1996 and base)	cluster1b	cluster2	cluster3	cluster4	total
Local Aman to HYV (ha)	132	113	36	104	385
D. Water Aman to HYV (ha)	110	124	54	34	322
D. Water Aman to Local Aman (ha)	113	372	362	198	1045
Fallow to D. Water Aman (ha)	130	71	250	151	602
Fallow to Local Aman (ha)	130	177	135	87	529
Fallow to HYV (ha)	96	57	0	14	167



1 0 1 2 3 Kilometers

scale 1:100 000
projection : UTM

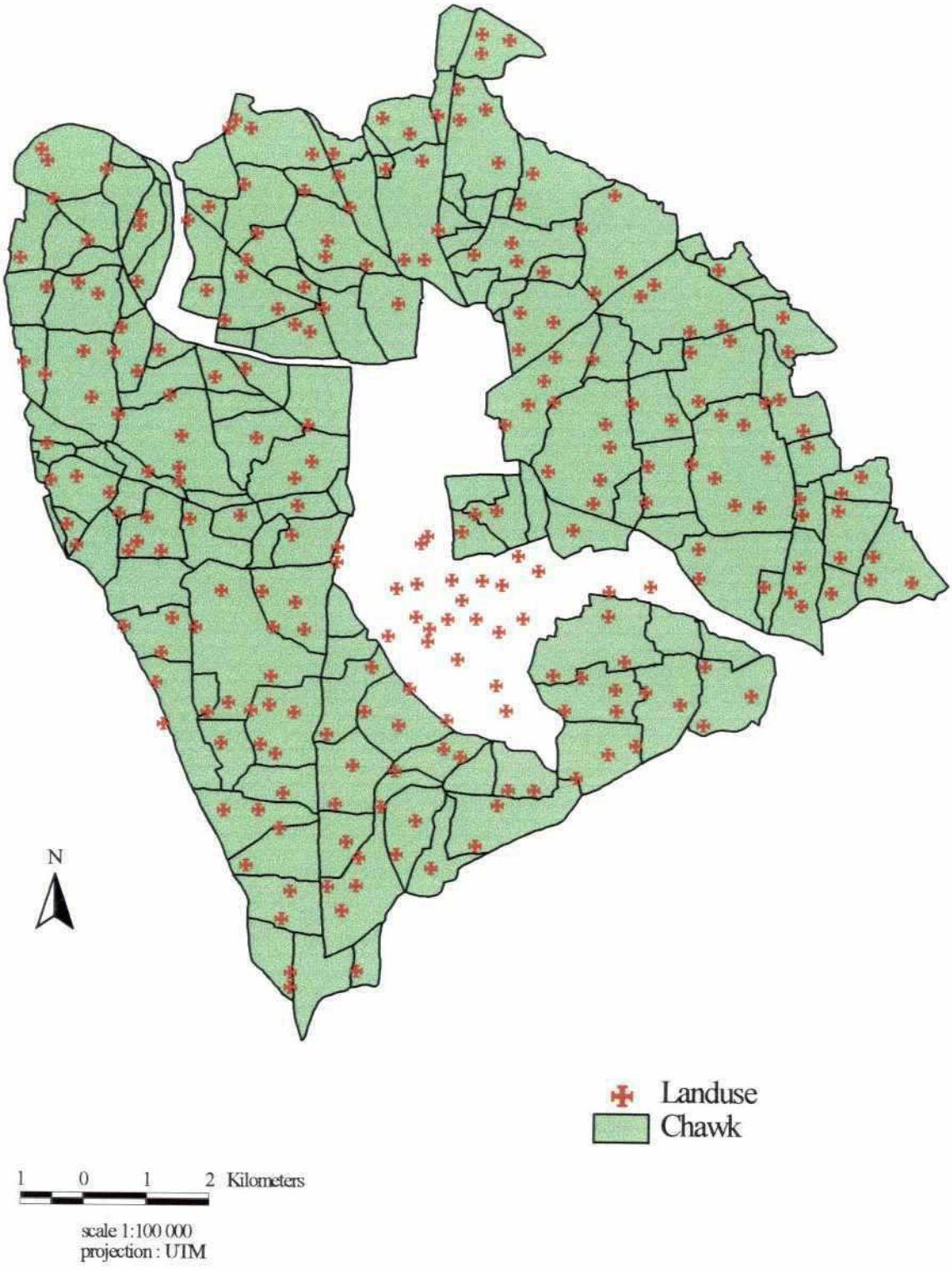
Sub-compartment

Compartmentalization Pilot Project Tangail

February, 97 c:\win32app\cppdata\cropt_96.apr

Figure 1.3: Location of monitoring plots

Fig 1.3 Location of Monitoring Plots



19 May 97 Monitor.apr SR

Compartmentalization Pilot Project Tangail

Current CPP approach and methodology

Current on-farm activities by CPP consist of demonstration plots of high yielding rice varieties and upland vegetable production plots by women, both implemented by CPP funding in collaboration with DAE. Furthermore, a small number of test plots were operated in 1994 and 1995 where the feasibility of a shift to more productive monsoon rice options was investigated. The tests were not carried out in 1996.

The need for a participatory approach

Rather than simply demonstrating new varieties and other improved technologies, the project should initiate a real participatory process for the identification of new technological options in co-operation with farmers. The effects of the project's interventions on water conditions in the compartment are still quite uncertain and farmers and project staff together should explore the implications through a continuing process of on-farm testing and demonstration of different options. These may include improved crop varieties, changes in landuse and cropping pattern, introduction of new rabi crops, fertility management through fertilizer, manure, compost, etc.

For on-farm testing and demonstration (OFTD) it is neither necessary nor desirable to scatter the testing plots over a wide area. The work will be carried out in compact OFTD sites where several farmers can participate simultaneously in the programme. Once adaptable technologies have been identified, they may be demonstrated more widely in the usual way by the extension service. Since the chawk is the basic water management unit of the project and the Chawk Water Committees (ChWC) have responsibility for water management at the chawk level, the chawk is also the logical organizational unit for participatory OFTD. Three pilot chawks (Annex-II) with contrasting conditions as regards hydrology, soils and cropping patterns to initiate the OFTD process were chosen. Results obtained in the pilot chawks can be demonstrated by DAE in other chawks

CPP-BARI-DAE co-operation in OFTD

On-farm research in Bangladesh is the task of the Bangladesh Institute of Agricultural Research (BARI) which has considerable experience in participatory on-farm research (OFR). BARI operates a prominent OFR site in Palima. close to the CPP area. In order to ensure long term sustainability, the project should establish a formal MoU with BARI at Tangail level to jointly conduct OFTD in the compartment. CPP being the client for BARI's services, the project will establish a contractual agreement with BARI which specifies the services rendered by BARI and the budget made available by CPP. The contract will be based on the activities proposed in this document. BARI would mainly provide technical and methodological inputs in the programme. Details will be worked out in the CPP-BARI contract.

Developing the OFTD programme

All activities under this theme will be carried out through an integrated OFTD programme in three carefully chosen pilot chawks, which capture the range of hydrological and cropping pattern variations in the compartment.The programme will farmer participatory methods with the maximum possible degree of farmer management of trials and demonstrations. A senior OFTD supervisory team is established, consisting of CPP (agronomist, deputy chief extension officer), BARI- Tangail (OFR scientists) and DAE (SMS crops). The CPP agronomist will be the overall co-ordinator and DCEO will maintain day to day management as per requirement and will keep constant liaison with BARI and DAE. The CPP drainage engineer, the fisheries expert, Institutional expert, the WID expert should co-operate closely with the team. For each pilot chawk a field team is established, consisting of an Extension Overseer of the project's team, the DAE Block Supervisor (part time) and CPP field staff. The Extension Overseer and the field staff of CPP should reside in a village associated with the chawk.The success of this programme will strongly rely on the DCEO/XO of the project team assisting the CPP's team.

The senior supervisory team calls a planning meeting of all its members plus the Project Director and the Team Leader as soon as possible to work out details of the OFTD programme.

The process of establishing and implementing the OFTD programme will involve the following elements (Annex III):

- definition of selection criteria for representative pilot chawks, including flooding conditions, soils, fisheries, etc.
- choice of three representative chawks using GIS-based information; preparing a full documentation of each chawk based on available information
- establishment of contacts with the chawk committees and with village authorities
- carrying out a PRA in each of the chawks to establish a first set of priorities, with emphasis on those issue which have a direct relationship to the changes in water management in the chawk
- establishment of a Farmer Testing Group (FTG) in each chawk, consisting of farmers interested to be involved in the OFTD programme
- if necessary, carrying out further characterization and mapping of the chawks
- designing possible new cropping scenarios with farmers for the assumed 'with project' situation, including a shift to more productive monsoon rice production, alternative irrigated rabi crops, etc.
- designing a first round of on-farm trials to test some of the options identified (under * above) in a participatory process with farmers. The use of a 'block-approach' will often be indicated.
- carrying out supporting studies, including monitoring of water levels, yield gap analysis in HYV rice cropping, an inventory of agricultural and horticultural species in the compartment.

The pilot chawks will form the experimental interface between the project's water management measures and real farming. They will be an excellent medium for practical investigations on new farming options resulting from improved water management and, equally importantly, their risks. The work should be co-ordinate with the water management activities of the project at the chawk and sub-compartment levels. Pilot investigation on pond and beel fisheries may also be conducted in the pilot chawks by the Fishery section.

Proposed activities for Theme II, 1997-2000

The programme carried out in the 3 pilot chawks is a continuing programme, extending over the remaining lifetime of the project and eventually beyond. For planning purpose specific activities are defined each year, according to the progress of the OFTD programme and the priorities developed with the farmers. For the 1997/1998 agricultural year the following activities are envisaged in the pilot chawks:

Establishment of the three pilot OFTD chawks. A planning meeting with the partners is held in March 1997 to develop a programme outline and planning schedule. GIS mapping of the chawks is completed. Field work will start in one chawk before the start of the 1997 monsoon season and in the other two before the 1997/1998 rabi season.The chawks will become a parmanent testing and demonstration facility of the project and its partners.

PRA. Four day to one week PRAs are held in each of the 3 pilot chawks. Farmer research and demonstration groups are established with interested farmers

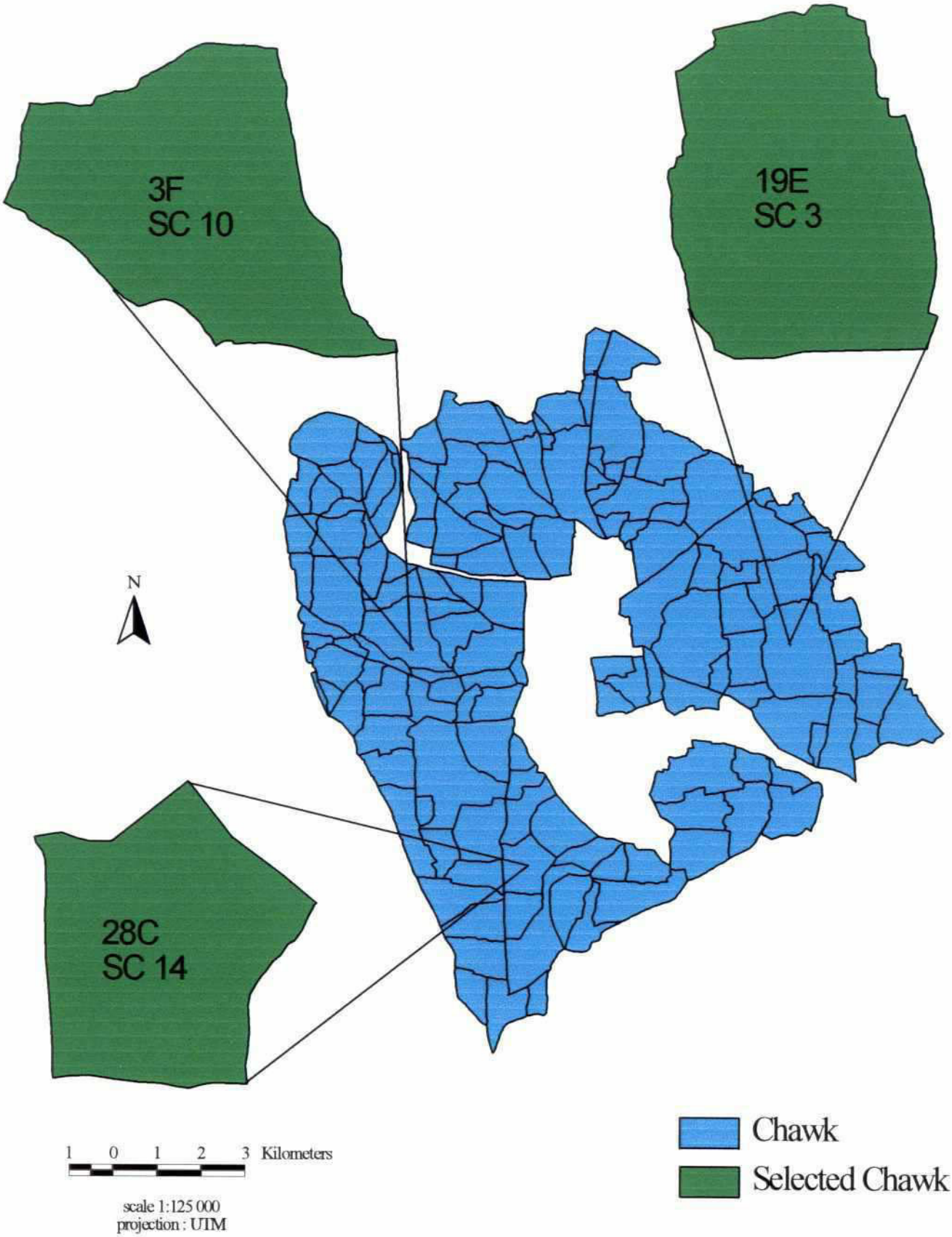
Design of on-farm tests and demonstrations. A first round of on-farm tests and demonstrations are designed in the pilot chawks in a participatory process with farmers. Future demonstrations on vegetable growing and IPM will also be established in the 3 pilot chawks. The vegetables are tested in agricultural land.

Inventory of agricultural and horticultural speciees. Information on all major and minor agricultural and horticultural plant species grown in the pilot chawk area will be collected.

Brief descriptions will be prepared on their production methods, use and economic importance in the sub-compartments where the pilot chawks are located. Some of these crops may have potential for larger scale (commercial) production in agricultural land.

Figure 1.4: Three selected pilot OFTD-chawks

Fig 1.4 Three Selected Pilot OFTD-Chawks



Compartmentalization Pilot Project Tangail

c:\windows\temp \oftd.apr 19 may 97 SR

On-going activities :

The following are on-going activities which will be continued in the compartment, in addition to those associated with the pilot chawks.

Demonstration of high yielding rice varieties. This is an on-going activity carried out across the compartment in collaboration with DAE. The only input provided by the project in 1997 will be the seed, which farmers will be asked to grow along side their local variety using their own cropping practices. This will allow measurement of the varieties' performance under real farmer management and avoid the artificial situation where crops are demonstrated at an input level which farmers cannot afford. This program will be discontinued from 1998 and handed over to DAE.

Demonstration of vegetable growing. A first set of winter vegetable demonstrations was established in homestead gardens by CPP funding in 1996 in collaboration with DAE. These demonstrations, which target women, will be continued in 1998. Future vegetable demonstrations will be set up in the context of the pilot chawks on agricultural land.

Irrigation survey. The bi-annual survey of irrigation facilities (deep and shallow tube wells and low lift pumps) will be repeated in 1997 and 1999. In combination with water table monitoring by the environmental section the data will provide important information on possible limitations to the use of ground water for rabi season irrigation. Conveyance/seepage loss is one of the main factors for the under performance of DTW. The survey/design will be done by Engineering Section of CPP.

In the coming years the programme will develop according to the priorities identified with farmer groups in the pilot chawks. Water level conditions in the chawks should be monitored and compared with target conditions according to the project's water management guidelines and model predictions. Yield levels and profitability of rabi crops should be monitored and yield gap analyses should be carried out for boro and t.aman rice.

Detailed works schedules manpower planning and main financial allocation areas follows:

1.6. Implications for some on-going and planned activities

There should be clear justification for each and every project activity on the basis of the project's goals and objectives. In the following paragraphs on-going and planned activities are re-examined to ascertain whether they do indeed follow from the project's goal and objectives and /or whether they will contribute essential information.

Monitoring plots in adjacent areas

Observations on cropping patterns in the adjacent area through 40 observation plots will provide qualitative information on the types of patterns used by farmers although the sample size is small for a reliable quantitative assessment of the occurrence of each pattern yet it will be possible to compare the patterns with inside the compartment.If the economists feel the data are needed they should use the same sample size as inside the compartment.

Integrated Pest Management

Although a very valuable approach in itself, at the moment there is no clear justification for a full-fledged IPM programme in agricultural section. It is however desirable to survey current pesticide use by crop and by season to further assess the likely impact of changes in cropping pattern. This program should be carried out by the environmental section,assisted by the agronomist. IPM may become a component of the chawk-based on-farm testing programme proposed above, but the general dissemination of IPM is the responsibility of DAE.

Crop demonstrations (rice varieties, winter vegetables)

Demonstrations sponsored by the project should have relevance for the project's objectives. For HYV of rice, this may be the case although it would be more appropriate if the demonstration were conducted in the context of changes in landuse rather than simply showing the varieties to farmers across the compartment. HYV demonstrations are, however, an on-going project activity which should not be abruptly discontinued, but for 1997 it is proposed to simplify the approach by only making seed of HYV available. After 1997 HYV demonstrations should become the responsibility of DAE, which already carries out similar work under its regular programme

The winter vegetable demonstrations in non-inundated land near the homestead do not have a direct relationship with project objective. They seem to have been motivated by the wish to do something for women. It is suggested that the demonstrations be continued during the current year and then transfer them to the DAE or to an NGO for adoption monitoring. Vegetable growing will be a component of OFTD in the pilot chawks.

Dependency of agricultural services

The question has been raised to what extent the necessary services will be available after the end of the project to continue proper functioning of the compartment. A questionnaire survey has therefore been proposed on the dependency of agricultural services' This should be the task of the socio-economic sections of the project, but before it is undertaken the objectives should be better defined. In particular, an inventory should first be made by the socio-economic sections with assistance from the agronomist of (i) the type of services which are required, (ii) those which are currently provided by the project and other organizations and (iii) who is expected to provide them in the future.

1.7. Institutional co-operation

Close co-operation will be established with DAE and BARI, as outlined above. Co-operation is needed both to facilitate the work of the project and to ensure sustainability and future continuity. Without strong co-operation now on the basis of a jointly agreed programme, the national institutions are unlikely to carry the work forward in the future, after the project has ended. The co-operation should be based on clear contractual agreements between CPP and its partners, specifying the services rendered by DAE and BARI and the financial means made available by CPP.

Monitoring the evolution of agricultural production (theme I) and on-farm identification, testing and demonstration of innovative farming practices (theme II) are both long term processes which should not end in 2000. The activities under both themes should be designed in such a way that they can be taken over by the national institutions. Therefore, monitoring and data collection (theme I) should satisfy the data requirements of both CPP and DAE and use methodologies which have future relevance for DAE (Annexs I and II). On-farm testing and demonstration of innovative options for farming should fit into the overall objectives of BARI and DAE. Once the work in the pilot chawks has started these organizations should start thinking how they could continue the work in the future. BARI is prepared in principle to incorporate its own on-going multi locational testing into the pilot chawks. This will be an additional assurance that the work will continue after the CPP project ends, but new funding will have to be identified by BARI and /or CPP for after the year 2000.

1.8. Organizational issues

Thematic groups

For internal and external planning purposes, thematic groups of senior CPP staff should be formed around the two themes. Tentatively, the composition of the thematic groups could be as follows:

Theme I : agronomist, economist, M&E specialist, environmentalist and DCEO.

Theme II : agronomist, economist, WID, Institution specialist, fisheries specialist, water management engineer, deputy chief extension officer.

The thematic groups are intended as an internal CPP planning, co-ordination and brain storming mechanism and they should meet regularly to discuss the on-going activities. They will also monitor the co-operation with officers of the relevant national institutions (DAE, BARI, etc).

Field teams for the pilot chawks

A field team will be needed for each of the 3 pilot chawks. These teams will consist of the following persons:

- one of the Extension Overseers of the augmented project team (full-time)
- the DAE Block Supervisor in whose block the chawk is located (part-time)
- a local secondary school graduate as a helper (full-time).

The team should be based in the village. They work under supervision of the senior OFTD supervisory team (above), assisted by BARI research assistant and CPP agricultural engineer.

2. DETAILED WORKPLAN, PERSONNEL REQUIREMENT AND BUDGET

Personnel and material requirements

In view of the broadened scope of the agricultural programm, an additional Junior Agricultural Officer will be required for the Agricultural section. The national consultant position in agronomy should be converted into a permanent position until the end of the project. The agricultural section should be able to occasionally call on supporting staff from other sections for specialized observations, such as water level measurements in monitoring plots and pilot chawks and species survey.

The OFTD programme requires recruitment of a local helper as a member of the field team of each chawk, as well as funds for field expenses.

The co-operation with BARI and DAE will have financial implications, which will be worked out in the collaborative contracts. They will include remuneration for the BARI staff involved in the OFTD programme and incentives for DAE Block Supervisors.

Since the collection of input/output data as well as other socio-economic data collection will now be the responsibility of the socio-economic sections themselves, they will need additional field staff and other facilities. These sections should work out their requirements in human and material resources.

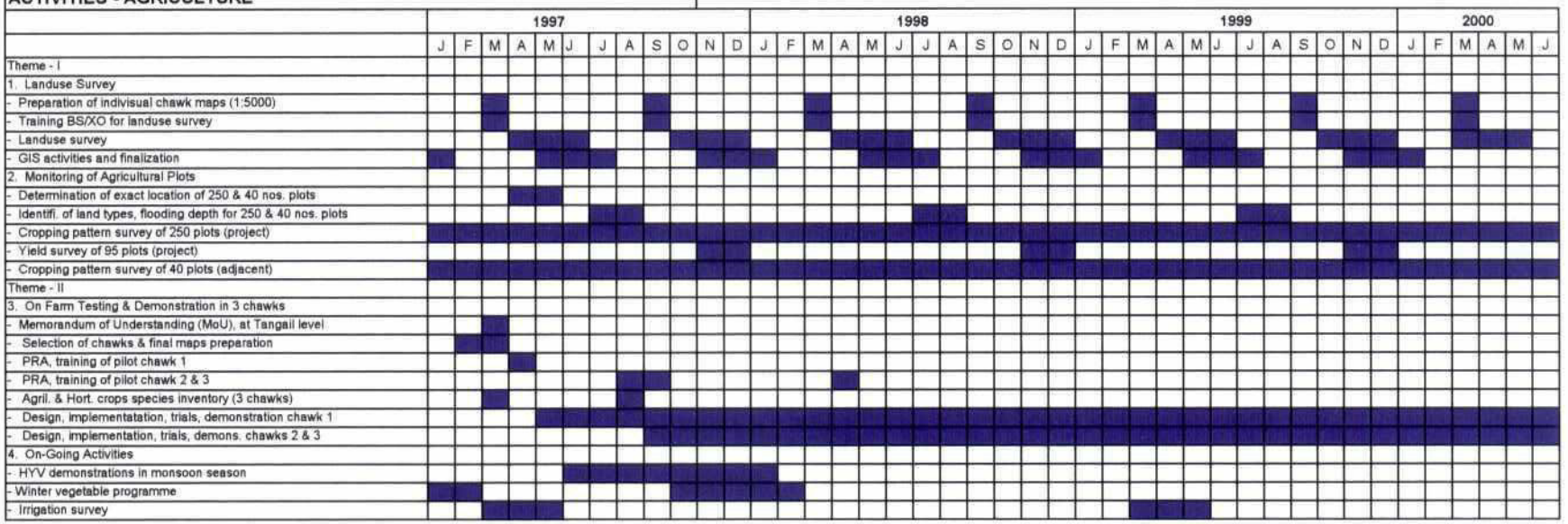
Training requirements

All staff involved in the pilot chawks should receive training in participatory methods, including PRA, before the pilot chawks become operational. The training should use one of the pilot chawks for its field

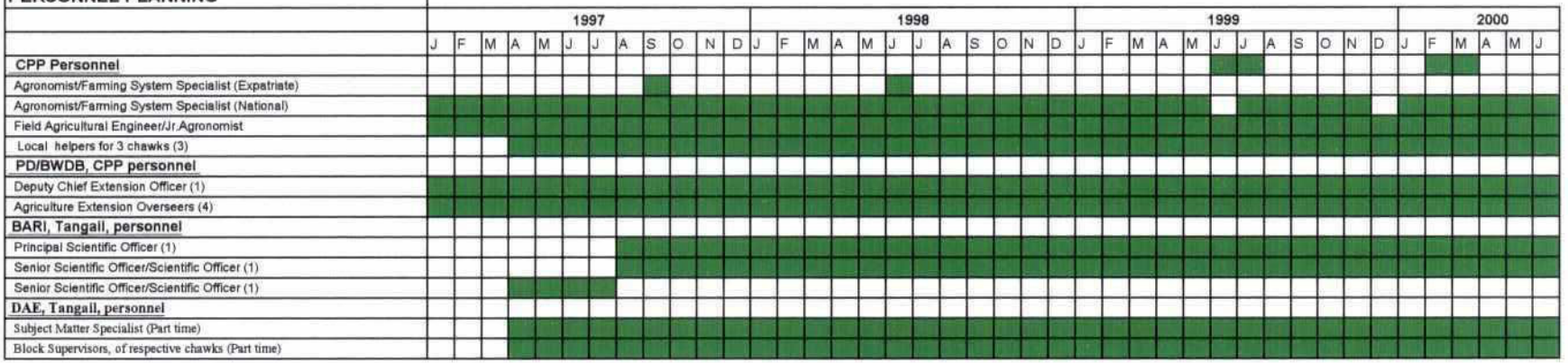
Figure 2.1: Detailed workplan, personnel requirement and budget : Agriculture

FIGURE 2.1: DETAILED WORKPLAN, PERSONNEL PLANNING AND BUDGET:

ACTIVITIES - AGRICULTURE



PERSONNEL PLANNING



BUDGET

	1997	1998	1999	2000	TOTAL
1. LANDUSE SURVEY	4000	4000	4000	2000	14000
2. OFTD					
Training and PRA	500	1000	1000	500	3000
Development Training Materials	2000	2500	3000		7500
Test and Demonstrators	5000	7500	7500	5000	25000
Interdepartmental cooperation	4500	6000	7500	7500	25500
3. ONGOING ACTIVITIES					
HYV demonstrations	4000				4000
Winter vegetable	-	4000			4000
Irrigation survey	2000		2000		4000
TOTAL (1+2+3)	**22500**	**25000**	**25000**	**15000**	**87000**

APPENDICES TO

ANNEX 1B

APPENDIX 1:	**LANDUSE SURVEY**

APPENDIX 2: **MONITORING PLOTS**

APPENDIX 3: **METHODOLOGY FOR OFTD IN THE PILOT CHAWKS**

APPENDIX 1: LANDUSE SURVEY

The landuse surveyor (agric,engineer) is testing a new approach, recommended by the M&E section based on aerial photographs (the 'Finmap'). The map is reproduced on a 1:5000 scale by simple photocopying. The chawks are identified on the map and for each chawk a separate sheet is made. The contrast can be chosen in such a way that the boundaries of most of the individual fields can be distinguished and the crop areas can be drawn on the map in different colours. The surveyor carries a second chawk map reproduced from the topo map for reference in case of doubt about the boundaries of the chawk. The results are traced on transparent paper and the individual chawk maps are digitized and transferred to the GIS. The method should give good results in the April/May survey when most field boundaries will be visible. For October/November reliable surveying by any method is bound to be difficult and will carry more error than the April/May survey.

It is recommended that the DAE/BS become associated with landuse mapping and gradually take over. As a first step,they should receive a few days training to familiarize them with the method, including a day of field application, to be delivered in March. During the next survey (April/May), the CPP surveyor should carry out the survey in collaboration with the BS, who on average cover 2-4 chawks. After doing one chawk together, the BS and XO, should be able to survey the other chawks under supervision and with correction from the CPP surveyor. A time schedule should be prepared during the training session.

Depending on the April/May survey, the following one can be handled to a larger extent by the BS and XO again after some training in view of the different field situation. The CPP will visit each BS and XO while he is conducting the surveys for guidance. The results should be checked with those of the previous survey for consistency and corrected in the field, if necessary.

APPENDICES TO

ANNEX 1B

APPENDIX 1: LANDUSE SURVEY

APPENDIX 2: MONITORING PLOTS

APPENDIX 3: METHODOLOGY FOR OFTD IN THE PILOT CHAWKS

APPENDIX 2: MONITORING PLOTS

Representativeness of the monitoring plots

The monitoring plots should be checked for representativeness. The land type to which they belong should be verified and the frequency in each land type must be compared with the overall frequency in the sub-compartment. In the first instance it should be tried to do this verification through GIS. This requires that the exact location of the plots be indicated on the chawk maps used in the land use survey. This may be done during the next survey in April/May. Fruthermore, any bias in location of the plots relative to roads and settlements should be assessed. This can also be done quantitatively through GIS once the exact location is known. A possible method has been discussed with the GIS specialist.

Sample size for yield estimates

The required numbers of plots for yield estimates through farmer's recall in rounded figures are as follows:

T-aman (H)	30
T-aman (L)	20
T-DWaman	15
B-DWaman	30

Assessing the reliability of farmer recall

Crop cuts should be taken in 5 fields for each rice type. In each of the fields 3 randomly chosen squares of 2x5 m sites are harvested and weighed on the spot. Preferably the crop cuts are taken at the time the farmer harvests the plot. It is not necessary to decide beforehand which plots will be sampled.
The threshing percentage may be obtained from secondary sources or measured from a sub-sample from a few fields only. A very high degree of precision is not required and would take too much time.
At between one and three weeks after the sampling the assistant returns to the farmer and asks about the yield of the field, in the same way as it is usually done.

APPENDICES TO

ANNEX 1B

APPENDIX 1: LANDUSE SURVEY

APPENDIX 2: MONITORING PLOTS

APPENDIX 3: METHODOLOGY FOR OFTD IN THE PILOT CHAWKS

APPENDIX 3: METHODOLOGY FOR OFTD IN THE PILOT CHAWKS

The OFTD concept

Farmer management

The guiding principle of the OFTD programme will be that farmers and are at the center of all activities. They will decide on the priorities for testing and demonstration in consultation with and advice from the OFTD team. They will carry out the tests and demonstrations with a minimum of interference from the team. The team guides the process and gives advice on implementation but does not impose its options. They will, however, provide inputs needed for the tests, but only to the extent that the inputs are different from farmers' usual practices. For tests and demonstrations involving risks for participating farmers, provisions should be agreed upon to compensate farmers in case of failure.These principles look simple but they are not easy to implement for people who are used to conventional extension approaches. BARI has experience with this approach and should ensure its proper application.

FarmerTesting Groups

A second principle is that of working through Farmer Testing Groups. Fortunately the Bangladesh DAE is also adopting a group approach to extension. A group of farmer participants in the OFTD programme is formed which is open to participation for all farmers working in the pilot chawk. Sub-groups will be formed from among its members around specific topics as they emerge during the OFTD programme. The Farmer Testing Group (FTG) and its sub-groups have an open structure. Farmers may join and drop out as they wish. For certain types of testing it will be necessary for farmers to conduct their tests in block of adjoining fields. During the rabi season, for example, testing alternative irrigated crops will be difficult in individual fields surrounded by boro. The sub-group will therefore need to recruit members so as to be able to form a block of adjoining fields to conduct the test.

Preparations for the OFTD programme

Choosing the pilot chawks

A preliminary choice has been made for three pilot chawks on the basis of the following criteria :

- they should cover the full range of conditions regarding soil and land type occurring in the compartment
- within each chawks there should be at least two land types based on monsoon water levels
- there should be a permanent beel and several fish ponds in the chawk

The chawks chosen were numbers 3F (204 ha), 19E (309 ha) and 28C (118 ha). Further characterization of the chawks should be done, using available GIS data, e.g. for base and current landuse,elevation and infrastructure base and target land types (based on modelled flooding depths), degree of water control, etc. The final decision on their choice should be based on this additional characterization.

Chawk committees and village authorities should be contacted as soon as possible after the final choice has been made to introduce the programme.

Conducting a PRA

A PRA should be conducted in the chawks under the leadership of BARI prior to starting the actual testing and demonstration programme. The first PRA should at the same time serve the purpose of training the involved staff in PRA methods, with the chawk serving as a case study for the training course. This will forego the need for a separate training course. The first chawk should be ready to start a simple testing and demonstration programme by the next Kharif season.

The PRA should result in a first set of priorities for the programme. In view of the objectives of the project priorities should be formulated with relevance for water management in the chawks and its consequences for farming

Establishing Farmer Testing Groups

During and after the PRA the villagers should be clearly informed about the aims of the OFTD programme. It should be emphasized that the team will assist farmers to conduct their own testing and that they will themselves be responsible for the demonstrations. Inputs will only be provided to the extent necessary for the tests and demonstrations and not for routine inputs which farmers normally apply to their crops.

Interested farmers will be invited to participate in a Farmer Testing Group and sub- groups are formed around topics for testing and demonstration, identified during the PRA. The main group and sub-groups will be an important mechanism for contact between the team and farmers, for monitoring and evaluation of the results of the work and for annual planning of the content of the programme.

On-farm technology testing and demonstration

On-farm tests and demonstrations are designed in close consultation with farmers through the FTGs and their sub-groups. They should be relevant from the perspective of the project's objectives. Any technology proposed for testing or demonstration should first be subjected to *ex-ante* analysis to verify its feasibility and potential profitability using information from secondary sources, including information available to the project. Possible marketing outlets should be verified. The feasibility of changes in cropping patterns in different land types of the chawks should be assessed on the basis of the project's predictions of the water management conditions in the chawks, The degree of risk should be carefully assessed and explained to farmers. Consultation with the water management engineers is crucial. No technologies should be tested which are unlikely to be profitable or whose products cannot be sold.

The tests and demonstrations should be carried out with a maximum of self-management by the participating farmers. Inputs are only made available to the extent that they exceed what farmers usually apply, including inputs for new crops which were not previously grown on agricultural land. In case of crop failure which is caused by the changes introduced in the trials and demonstrations, participating farmers should be compensated. The conditions for compensation should be clearly spelled out and explained before the start of the season.
The number of plots required for farmer-managed test will not be less than 20 per chawk to allow statistical analysis. In view of the high degree of farmer management this should present no undue problems. Some types of trials and demonstrations will have to be carried out in a number of adjacent fields ('block tests and demonstrations'), for example when testing a new irrigated crop in an area where most fields are planted to boro.

Farmer field days are held during the season. Tests and demonstrations are subjected to statistical and economic analysis and the results are thoroughly discussed with the participating farmers.

ABBREVIATIONS

Beel	Local depression filled with water most of the year
CC	Compartment Committee (Project Council)
CDO	Controlled Drainage Outlet
FCDI	Flood Control Drainage and Irrigation
FMM	Flood Management Model
FDAM	Flood Damage Assessment Modelling
GIS	Geographic Information System
GPC	Gated Pipe Culvert
JWMO	Junior Water Management Officer (Cluster level)
Khal	Drain
LFP	Lohajang Flood Plain
LGED	Local Government Engineering Department
O&M	Operation and Maintenance
SC	Sub-compartment
SCWMC	Sub-Compartment Water Management Committee
SMS	Subject Matter Specialist
SRP	Systems Rehabilitation Project
TOR	Terms of Reference
UP	Union Parishad
WCS	Water Control Structure
WME	Water Management Engineer
WUG	Water Users Group